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December 4, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

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Read the interesting Coca-Cola letter at the left—which states how Goodrich Wireless Tires have proved "far superior to any tire ever used."

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Eighteenth Annual Motor Number

OF THE

SCIENTIFIC AMERICAN

January 1st, 1916

FROM its earliest days the Scientific American has recorded the progress of the motor-driven vehicle. The first account of an automobile appeared in the Scientific American of October 2d, 1845. It described a steam-driven carriage steered by means of reins. Since then every important development of the automobile has been announced in this journal.

At the very dawn of the automobile era, before the public realized the tremendous importance that this type of transportation was soon to assume, the Scientific American began publishing an annual automobile issue devoted to the progress of motor-driven vehicles.

The next annual issue, which is the eighteenth, will contain a vast amount of material that will be invaluable to every motor car owner.

There will be an article on the car of 1916, explaining changes in design and construction that will be prominent in the product of the forthcoming year. Developments in commercial cars will also be covered by a special article, the author of which is a man who has made a close study of motor trucks.

The increasing use of high-speed multiple-cylinder engines makes the article on "Saving the Car by Careful Driving" of particular importance. Handling a car of the new type is very different from that of two or three years ago.

The car of to-day contains so much electrical apparatus that automobile owners will welcome the article on the care of the electric starter and ignition systems. At present, a motorist who may be good at repairing mechanical defects in his engine feels absolutely helpless when any trouble develops in his electrical equipment. Instructions as to the repair and care of this equipment have been prepared by an able engineer who explains everything in very simple terms, with illuminating illustrations.

Henry B. Joy, President of the Lincoln Highway Association, tells very interestingly what has been done toward the completion of this great national highway, describing the scenic beauties along the way and pointing out the benefits that will accrue from this important link joining the Pacific with the Atlantic.

These are but a few of the subjects that will be covered in this number. Following the custom of previous years, the issue will contain charts of gasoline and electric motor cars, both of the pleasure and the commercial type, giving the names of manufacturers and the prices of cars. The material is arranged in such form as to constitute a very valuable price list and reference table for prospective purchasers of motor vehicles.

A colored cover by Howard V. Brown

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Ask the man who owns one

SEVENTY-FIRST YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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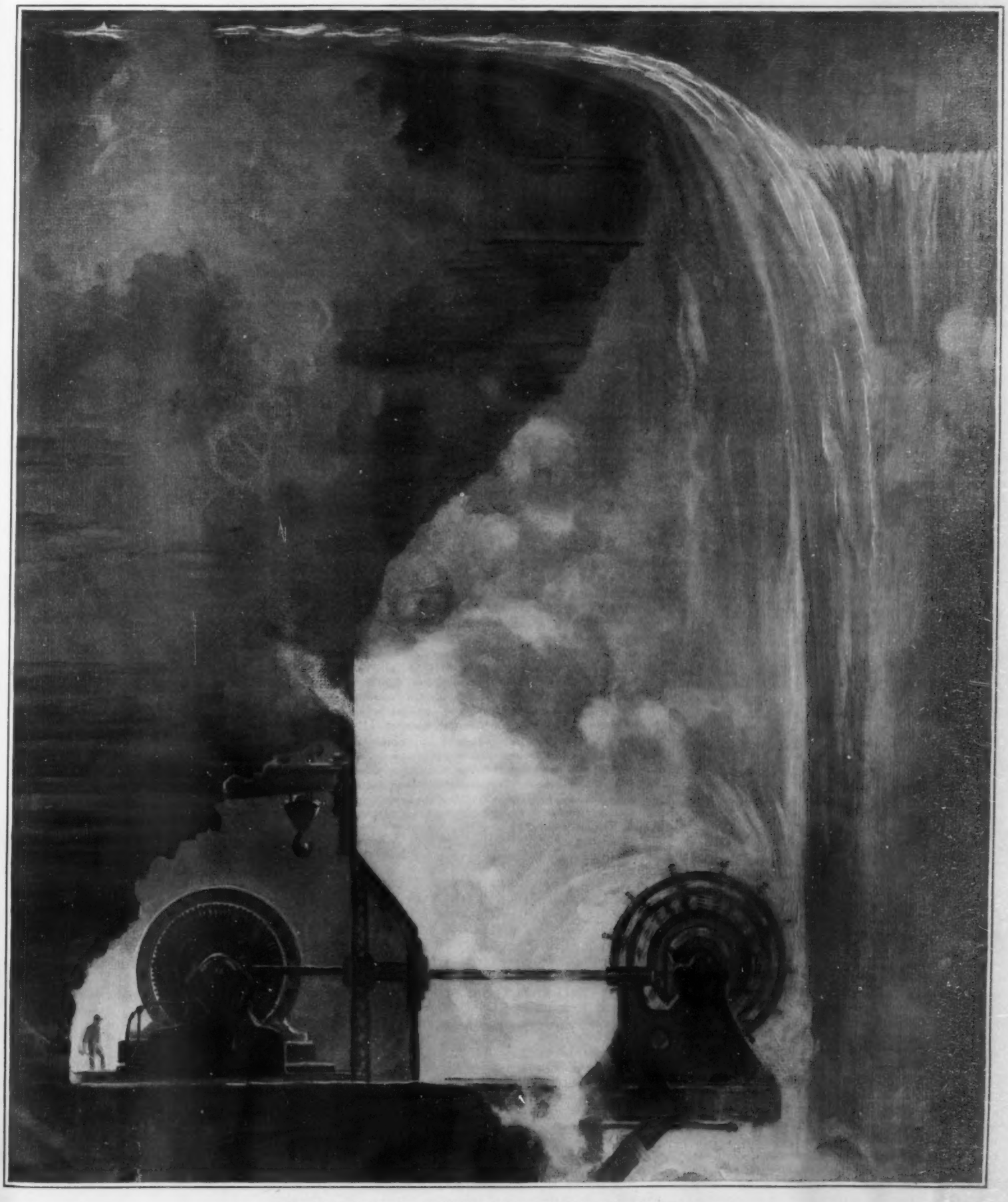

A scheme for using the power of Niagara Falls without impairing its scenic beauty
THE INTERMITTENT WATERFALL. [See page 492]

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

"The Valor of Ignorance"

THE plans of the Wilson Administration for making a considerable increase in our Naval forces have been the subject of a savage attack by Representative Kitchin, of North Carolina. Mr. Kitchin makes a series of statements regarding the present strength of our Navy, which are so utterly misleading, so widely at variance with the well-known facts, that, were it not for the responsible position which he holds, we should be inclined seriously to doubt his sincerity. It is because Mr. Kitchin holds a responsible positon in what is, or ought to be, the most reliable and authoritative body of men in the United States, whose public utterances upon great public questions are received as gospel truth by millions of citizens who have neither the time nor the opportunity to investigate these questions for themselves, that such gross misstatements as those which the Representative has made about our Navy should meet with instant and most emphatic denial.

If the blame for the defenselessness of the United States is traceable to one cause more than to any other, it is to be laid at the door of those Congressmen, of whom Mr. Kitchin is the most glaring example, who, having a most superficial knowledge of Naval and Military matters, have persistently disregarded the recommendations of our Naval experts and have set themselves up as the judges as to how big a Navy we require, as to what kind of fighting ships we should build, and as to what proportion in numbers the various types of ships should bear to one another.

In the first place, Mr. Kitchin states that our Navy is far superior to that of Germany, since "we have nineteen dreadnoughts or superdreadnoughts to Germany's sixteen." Now, whether by accident or from intelligent appreciation of the problem, Mr. Kitchin is quite correct in basing his estimate of relative Naval strength upon the dreadnought. For the dreadnought is the supreme fighting element of the modern Navy, around which all the other types of ships are grouped, to which they minister, and without which a Navy, however great it might be in numbers, would cease to have any first-class military value. Now, Mr. Kitchin, we take it, is speaking in terms of the present strength of the fleets of the United States and Germany, the actual fighting strength available to-day for the shock of battle. Figuring on this basis, we find that the United States has in commission only eight dreadnoughts which it could oppose to the twenty-two dreadnoughts which the German Navy has in commission.

"Why in Heaven's name," says he, "do we have the demand that we act as if we were totally unprepared?" We answer, that it is because, on the basis of the figures we have given above, the first fighting line of German dreadnoughts is over two and one-half times as powerful as our own.

Now, among those twenty-two dreadnoughts are to be found five battle-cruisers of from 28 to 29-knots speed, and against these ships we could oppose to-day not a single one! Furthermore, against Germany's fleet of a dozen fast scout cruisers of 28-knots speed, we could oppose but three of 22 to 23-knots speed and of obsolescent pattern.

Judging from the general character of Mr. Kitchin's criticisms, it is conceivable that he has not the slightest idea of the disastrous consequences which, in case of a Naval war, would result from our total lack of a numerous and powerful scouting fleet. Therefore, for the enlightenment of himself and those who may have been misled by his statements, we point out that in case of the dispatch of the German Navy to the coast of America, it would be imperative for Admiral Fletcher to obtain the earliest possible information as to the strength of the German fleet, its whereabouts on the Atlantic, and its probable line of approach. Far in advance of the invading fleet and stretched out fanwise, would be a long line of these fast scouts and battle-cruisers. Thrown out in advance of the defending fleet would be our own line of scouts, such as it was, being made up of our three 23-knot scouts, some of our armored cruisers, and a number of destroyers drawn away from the main battleship fleet, which would be vulnerable by destroyer attack because of this depletion. When these two scouting lines came in touch, our own ships would be utterly unable to pass through the German line because of the presence of her battle-cruisers. They would be driven back upon the main fleet, and the German Admiral would be able to obtain full information as to the position and strength of our forces, while we ourselves would be absolutely without any information as to the enemy.

Is Mr. Kitchin aware that both in the war game played last spring and in that of last autumn the defending fleet, because of its lack of scouts and battle-cruisers (both of which were possessed by the invader) was unable to find out anything about the attacking force, which on both occasions eluded the defending fleet and made its descent undetected and unopposed upon our coasts.

In view of the above facts, how preposterous becomes the following statement by this self-appointed critic of our Navy: "Why are our coasts safe from attack to-day even if not one dollar more is spent beyond that now authorized? Because of coast defenses, mines, submarines and a fleet that is far superior to that of Germany."

In predreadnoughts, it is true, we are stronger than Germany, having twenty-one against her twenty, and our ships, in respect of protection and gun power, are individually much superior. But it must be remembered that the final issue of a Naval campaign will be decided by the strength of the dreadnought line; and not even Mr. Kitchin's optimism would lead him to expect that our fighting line of eight such ships would prevail over Germany's twenty-two. Mr. Daniels never said a truer thing during all the incumbency of his office, than when he stated that the captain who attempted to fight a dreadnought with a predreadnought would be a fit subject for court-martial.

Following out our comparison, we find that the United States could oppose sixty destroyers against Germany's fleet of one hundred and fifty, and that against her still-numerous fleet of big, able, fast and thoroughly seaworthy submarines, trained to the hour by many months of arduous service in the field of actual warfare, we could oppose a heterogeneous collection of small, non-seagoing submarines, which, in the recent fall maneuvers, proved to be capable of making only four or five knots in the moderate seas which were running at the time.

Just a word more on this subject of the submarine. Representative Kitchin evidently belongs to that school of lay thought, which believes that in the small and relatively cheap submarine we have an economical means of defense, which will enable us to laugh at a fleet of costly battleships and hold it, by the mere threat of destruction, from our own waters. The matter was tested out pretty thoroughly in the fall maneuvers referred to, when a group of eight of our latest submarines were told to string themselves out in line, one hundred miles or so south of Nantucket, and intercept the enemy should he try to make his approach toward Boston and Newport. The flotilla developed troubles before it reached its assigned position, and on being notified in the evening that it was to proceed one hundred and twenty-five miles to the southward, it was in such bad shape that by morning, instead of having covered the distance, it had made only twenty-five miles at an average speed of some four or five knots. More than half of the boats were able to use only one engine at a time, and ultimately they received notification by wireless to get back to a home port as best they might.

In view of the superb performances of the German submarines, we ask Mr. Kitchin, once more, to tell us and the world at large just how he arrives at his conviction that our fleet, as it stands to-day, is "far superior to that of Germany."

Pulp From Cotton Stalks

HERETOFORE the cotton plant stalks have been considered absolutely valueless if not as a troublesome feature incidental to the growing of cotton. After the picking of the cotton crop the stalks had to be cut and burned at a cost of about $1.00 per ton. And it must be borne in mind that there are approximately 5 tons of stalks to every ton of cotton, so that the cost of this unproductive labor has been considerable.

A use for cotton stalks has finally been developed and although the resultant industry is only beginning, it promises to be an important one. Already a plant is being erected at Greenwood, Miss., which will be devoted to the preparation of pulp from cotton stalks.

In the main the cotton stalks after being converted into pulp are to be used in the place of wood pulp in paper making. Because of the stronger fibres of the cotton stalk pulp, it is said that paper manufactured from this cheaper pulp is considerably stronger in proportion to its thickness and weight than that produced from the usual wood pulp.

With the continually increasing consumption of wood pulp there exists the danger of a serious depletion of the country's forests. Even if reforestation were carried out on a scale equivalent to the consumption of timber used in paper making, a time would soon be reached when the paper fibre would have to be raised as a crop.

The use of cotton pulp is not limited to the making of paper. The cotton stalk fibres have been found capable of withstanding the nitrating process involved in the making of gun cotton. On the other hand, wood pulp cannot be employed in producing gun cotton, since the fibres do not withstand the carbonizing effect of the acids. Cotton has heretofore been used in the making of guncotton, and much of the cotton will be released in the future for other purposes.

Aside from the two afore-mentioned products, there are many others that may be derived from the cotton stalks, among them being artificial silk. The latter is produced by first dissolving the pulp in amyl acetate. The resultant viscous liquid may be spun into threads of any desired size and used singly or twisted together if the strands are fine. The threads thus secured may be woven into fabrics and used in the making of wearing apparel of all kinds. Although artificial silk produced in this manner has a shorter life than pure silk, still the difference in cost between the two more than balances its shorter life.

The same viscous liquid can be colored and drawn out into sheets which, after drying, have the appearance of ordinary leather or alligator skin. In point of uniformity the artificial product possesses a marked advantage over natural skins. Motion picture films can be made by running the liquid into thin strips which are coated on one side with the photographic emulsion after they have been dried and finished.

Among the numerous other uses of the cotton pulp may be mentioned those of making pyroxilene, alcohol, acetone, and a variety of other chemicals almost too numerous to mention.

Incidentally, the cotton stalk industry will accomplish a mission of great importance as regards the cotton crop proper. In removing the stalks it has been the practice in the past to cut them off near the ground and leave the roots. During the winter months the little boll weevil makes his home in the cotton plant roots awaiting the advent of the following summer for a campaign of destruction directed against the cotton crop. With the removal of the roots—which are as valuable to the paper-maker as the upper part of the plant and will therefore be included with the stalks—the weevil will not only be deprived of a shelter but also of his food and thus will be compelled to leave the cotton fields. The boll weevil has in the past been responsible for millions of dollars' destruction to cotton crops each year.

There does not appear to be a possibility of a shortage in the supply of cotton stalks even after the new industry has grown to the expected proportions. During the past few years 75,000,000 tons of cotton stalks have been destroyed annually. Unlike the wood that is cut for pulp and which requires years to grow again, the cotton stalks are a by-product of cotton and therefore are available each year in as great abundance as the preceding years, as long as cotton is grown.

Opening of a Railway Tunnel in Turkey

UNDOUBTEDLY the most important event in railroad construction in Turkey to date is the recent completion of the large tunnel on the Bagdad Railroad, piercing the Amanus Mountains on the border between Asia Minor and Syria. It is known as the Baghtché Tunnel.

With the completion of the Baghtché Tunnel the most serious difficulties connected with the construction of the Bagdad Railroad have been overcome, and the work of connecting up many of the isolated stretches of track may be expected to be completed with reasonable rapidity, despite the war in which Turkey is engaged.

The new tunnel is three miles in length—by far the longest in Turkey. While the tunnel is not as long as many found in the Alps, it is claimed that the engineering difficulties encountered in boring the Baghtché Tunnel have been as great as those encountered elsewhere. For several hundred yards the engineers were confronted with a rock of practically pure quartz, which was so hard that it was necessary to have recourse to boring machines of special construction. The tunnel is on a grade and emerges at one end 197 feet above the level of the entrance, after having reached at one point a level of 246 feet above that of the entrance. The railroad leading to the tunnel passes over eight steel bridges and through nine small tunnels.

Notes on the War

Losses of the British Merchant Marine.— Last month the British Admiralty gave out valuable statistics regarding the losses of merchant ships during the war. The number of British merchant ships sunk by submarines was 183, of which 93 were destroyed by torpedoes. In addition to these, 175 British fishing vessels were sunk. At the outbreak of the war, Great Britain possessed 11,028 ships—about 40 per cent of the world's shipping. Because the 2,845 merchant ships of the German and Austrian fleets had been destroyed or driven into port, the proportionate strength of the British merchant navy had been considerably larger than 40 per cent. Due to the activity in ship-building, the losses of the British merchant marine have been more than offset by its growth, the fleet being larger by 88 ships and 343,616 tons than it was when the war commenced.

The Total German Resources in Men.—Commenting on a characteristic German propaganda article in a neutral country, Belloc criticises the statement that "the German Empire alone was prepared to put in the field a total of 12,000,000 men." It is generally agreed that a nation is able to mobilize about one tenth of its population; but Belloc admits that when the effort is extended to a second year and when a supreme effort is made and a few elements not quite desirable are introduced, you may just reach 12 per cent. Twelve millions of men for Germany, however, means over 17 per cent, and it would include children, elderly men, invalids, lunatics, cripples, blind and paralytics. The French General Staff have calculated as a maximum for the Germans somewhat over 8,000,000, this calculation being based upon the knowledge of what they can themselves do with a population at least as healthy.

England as a Future Military Power.—A writer in the *United Service Magazine* lays emphasis on the fact that when the armies now under training have been brought up to full efficiency, England will be an important military power, even when compared to the great armed nations of Europe. He draws attention to the influence on the world-power of England that the existence of a great army, available for service in any portion of the Empire, must have in the present and the immediate future. Military strength is not counted in numbers, but it is the power to be strong at the strategical point. With her new land forces England's supremacy on the seas gives her this power. The writer thinks that after the war there will not be a reversion to the old order of things military: since the popular prejudice against the profession of arms will have largely, if not completely, broken down.

Submarine Activity in the Baltic.— It will be interesting to learn when the war is over how the British submarines managed to break through the narrow straits leading from the North Sea into the Baltic. That they have done so, probably in considerable numbers, is shown by their great activity against the contraband trade between Scandinavia and the German Baltic ports. Apparently the fleet has recently been augmented by at least two flotillas of submarines; for according to a dispatch from Copenhagen, a flotilla of destroyers headed by a light cruiser of the "Undaunted" type convoyed the submarines to the entrance of the Cattegat, at the Northern-most point of the Jutland coast. The light cruiser remained here while the destroyers convoyed the submarines to the narrowest part of the Sound at Elsinore, whence they made their way unaided into the Baltic. Once they are in these waters, they can be operated from bases on the Russian coast; and in their attacks upon German shipping they are not handicapped by the vast distances which had to be covered by the German U-boats before they reached the trade routes.

The New British Monitors.—The British have been so well pleased with the work of the small monitors, that they have launched out into the construction of a larger class carrying guns of 14-inch calibre. The following description by Ellis A. Bartlett of some of these monitors at the Dardanelles is illuminating: "It was impossible to tell at a distance whether the craft was broadside on, stem on, or stern on, for she seemed to be quite round. On the top deck, nothing showed except an enormous turret from which projected two 14-inch guns." They set off in boats to investigate, and found that just below the surface the sides "bulged out some 10 feet and then turned under, affording a platform just washed by the waves. If a torpedo strikes the side of the vessel it will explode in a variety of substances which I must not mention and the hull of the vessel will escape injury." It is more than likely that instead of the "variety of substances" the space between the vertical wall of the outside shell and the hull proper of the ship is filled with water and that this space is open to the sea. This would have the advantage that the blowing in of the outer shell by torpedoes would not increase the displacement of the vessel or produce any list.

Science

St. Pierre, Martinique, which was destroyed by the eruption of Mont Pelé in 1902 is again beginning to assume the importance of a town, according to the U. S. Consul at Fort de France. The surrounding country is also being rehabilitated; plantations have again been brought under cultivation and the cultivated area is increasing each year.

Agricultural Experiment Stations In China.—During the present year the government of China has allotted $100,000 to the establishment of agricultural experiment stations, and now has in operation three cotton farms, one sugar plantation, two forestry stations, and three pasturage farms. The government also has a model ranch at Chu Chow, in northern Anhui, under the direction of an American ranchman. A corps of lecturers and demonstrators is being trained for agricultural extension work throughout the country.

The Influence of Different Soils Upon the Composition of Wheat is the subject of an investigation undertaken this year by the U. S. Bureau of Chemistry. The effects of several kinds of soil will be tested under identical atmospheric conditions. The programme contemplates transporting to the Arlington Experimental Farm 1-320th of an acre of soil, 3 feet deep, consisting of about 16 tons each of sandy clay, marl, muck, and a good agricultural soil, and in each of these plants the same seed will be grown.

The Plants Used by the American Aborigines form the subject of a special investigation which the U. S. Bureau of Plant Industry has been carrying on for some years. All available literature on exploration, early travels and settlement in this country, as well as later publications, are searched for information as to the knowledge which the aborigines possessed regarding the uses of plants, and this information is abstracted and filed under the name of each plant. It is expected that this undertaking will not be completed for publication before the year 1924.

The Introduction of Foreign Seeds and Plants by the U. S. Department of Agriculture has assumed immense proportions. The total number of varieties introduced since 1907, when the Section of Seed and Plant Introduction was established, amounted last July to over 40,600. During the past year more than 2,000 varieties were introduced, while 171,831 experimental plants and 11,465 packets of seed were placed with experimenters, and a record was kept of each. During the same year over 500 shipments of experimental seeds and plants were made to foreign agricultural institutions, in exchange for material sent to this country by them.

Native Vegetation as an Index of the Value of Land.—When it is proposed to bring a tract of land under cultivation for the first time, information as to the soil and climate is always an urgent desideratum, in order that the farmer may select the crops and methods of culture best adapted to the locality. In the absence of other information under these heads, the types of vegetation growing wild on the land are obviously of much significance. In recent years the U. S. Bureau of Plant Industry has been developing along scientific lines an "indicator-plant" method of classifying lands in the arid and semi-arid portions of the United States. During the last fiscal year work of this character was carried on in southwestern Utah, southern Nevada, southern California, and southern Arizona. In all these regions the native vegetation was found to be indicative of whether the land was suitable for dry farming and whether the amount of alkali present was sufficient to injure crop plants under irrigation.

Protection From Lightning.—Investigations on this subject have been in progress at the U. S. Bureau of Standards during the past two years, and the results are incorporated in a report by O. S. Peters, now in the press. Statistics of lightning damage have been gathered from reports of the Census Bureau, Weather Bureau, insurance companies, fire marshals, etc. Mr. Peters finds that the property loss by lightning for this country averages about $8,000,000 a year, of which by far the greater part occurs in rural districts. The number of casualties among human beings, due to lightning, averages 1,500, of which about one third are fatal. Nine tenths of these accidents occur in rural districts. Lightning-rods are found to reduce the fire hazard from lightning by 80 to 90 per cent in the case of houses, and as much as 99 per cent in the case of barns. Mr. Peters' report, according to an advance abstract published in the *Journal of the Franklin Institute*, will present quite a comprehensive digest of what is known at the present day regarding the mechanism of the lightning discharge. Concerning the long-mooted question as to whether lightning is an alternating discharge, or otherwise, the author says that "the best obtainable evidence" points to its being unidirectional and of steep wave-front.

Automobile Notes

Long Test for an Electric Car.—An electric delivery automobile was recently given a severe test by running it from New York to Cleveland, a distance of 733 miles, which is said to be the longest run ever made by an electric. Eleven days were required, and the total current consumption was 1,564 ampere hours. The batteries were charged twenty-five times, and no adjustments were found necessary, the entire distance being covered without a mishap of any kind.

Protecting Leaf Springs.—Simple and effective is the remedy which a British inventor suggests against the frequent clogging of dirt and dust between the leaves of automobile springs. It consists of "gaiters" strapped over the springs—two gaiters to each spring. Cars, provided with such gaiters, have been run for a year under trying weather and road conditions and their springs have been found in excellent shape at the end of that time, without lubrication or other attention during the year. This is but an adaptation of the foot that has been used on universal joints and other exposed parts and is not protected by patent, and any motorist may take advantage of the inventor's ingenuity by making, or having made, his own protectors.

An American Car Tested in England.—Officials of the Royal Automobile Club of London recently conducted a test of a prominent American car. Selecting at random a car out of a shipment of 44, they saw it taken from the shipping crate, and after adjustments requiring but 3 minutes and 39 seconds had been made, the car started on a trial run under the supervision of the club officials. The route included ordinary road and hill conditions, and covered 75.5 miles. The car ran well, and the consumption was but 3¾ gallons of gasoline, equivalent to 20.13 miles per gallon, or 29 ton miles per gallon, which must be considered remarkably satisfactory, especially in view of the fact that the car was new, and that the adjustments and preparations for the test were entirely superficial.

Iowa the Automobile Sales Barometer.—Although many other states show a larger number of registered automobiles, Iowa boasts of more car owners in proportion to its population, and for this reason has come to be regarded by automobile manufacturers as a sort of business barometer. But while the business done in automobiles in this state may have had significance in the past, it is open to question how long it will continue to be a safe guide. Essentially, Iowa is an agricultural state, and, although there has been a rush of farmer's business for a few years, it would seem that the demand of this class of buyers is about equalized; and consequently, if we must have a barometer of this kind, some state representing more diverse, and more average, business conditions must be selected. In any case the special conditions caused by "war business" must cause a disturbing influence, this year at least, that will upset all theories.

Piston Rings in Segments.—Cutting a piston ring into three segments and then providing for the proper placing and holding of these segments in position, is the radical innovation made by a British manufacturer. The piston has recesses spaced at equal distances around the circumference, into which plugs are fitted. These plugs are slotted to receive the piston ring, while in the bottom of each plug is seated a small helical spring forcing the ring against the cylinder walls. One of the plugs carries a center pin, which projects into small recesses in the ends of two of the ring segments. This pin keeps the ring as a whole from turning. Compression is said to be exceptionally good, while frictional losses are small in the new piston, due to the fact that but one ring is used, and this ring is firmly and equally pressed against the inside of the cylinder.

Unequal Tires Cause Trouble.—One of the results of the recent increase in so-called "oversize" tires in the United States has been the growth of rear axle troubles, due to the fact that many motorists will put a "regular" 34 x 4 tire on one rear wheel, and an oversized tire of a different make on the other rear wheel. Theoretically both tires are 34 x 4, but in practice the oversize tire is nearer 34½ x 4¼. Careful measurement of tires of different makes will sometimes show a variation of ½ an inch, and even more in the outside diameter. Plain tread and non-skid of the same make will occasionally show similar variations. One motorist who used tires of different makes, which on examination proved to differ by nearly ¾ of an inch, calls attention to the troubles he had before he located the cause: His rear axle casing leaked oil, as did the brake drum on the wheel with the smaller tire; steering was interfered with, and the tires wore off unevenly and rapidly. In one case two tires 34 x 4 were measured, with the following result: One was 34½ x 4$^{3}/_{16}$, the other 33¾ x 3⅞; the difference in distance between clinchers was ⅝ inch in favor of the first tire. From these experiments it would seem that tires of the same type and make should be used on the wheels of the same axle.

Recent German Naval Construction

By M. K. Barnett

FOR some months past a shroud of mystery has enveloped the warships under construction in German yards.

The situation at the commencement of the war was as follows:

A class of four battleships of the "Koenig" type was nearing completion, her sister ships being the "Grosse Kurfurst," "Markgraf" and "Kronprinz." These were designed for a displacement of 25,575 tons, with engines of 34,000 horsepower. They aimed at a minimum speed of 21.5 knots, while ten 12-inch guns were chosen as a main armament.

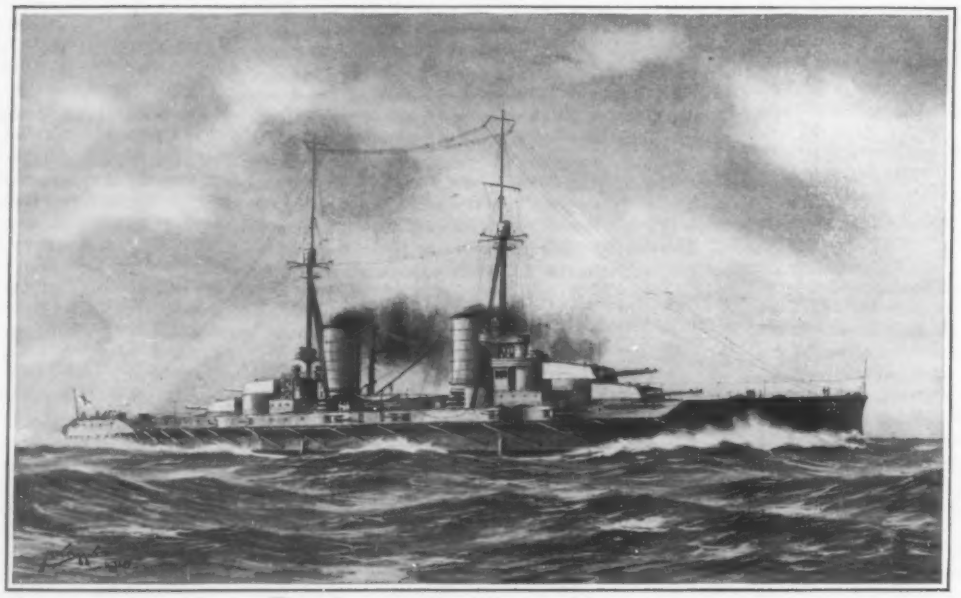
In addition to these, there were three battle-cruisers in an advanced stage of construction, the "Derfflinger," "Lutzow" and "Ersatz Hertha." The design of these being, displacement 26,600 tons, armament eight 12-inch guns and speed 27 knots. The only other capital ship approaching completion was the "Salamis," then building for Greece.

A certain German naval officer, interned in Holland, stated in June last that the "Kronprinz" and "Lutzow" (the former the last vessel of the "Koenig" type of battleship, and the latter a battle-cruiser of the "Derfflinger" class) had been re-armed and completed with 15-inch guns instead of the usual German 12-inch weapon.

The assertion that the "Kronprinz" and "Lutzow" were completed in June last is probably correct, but they were far too near completion for re-arming at the time when the "Queen Elizabeth" started bombardment in the Dardanelles. Yet the officer definitely stated that it was the news of the success of the British 15-inch gun in this work that caused the German shipbuilders to re-arm these two ships.

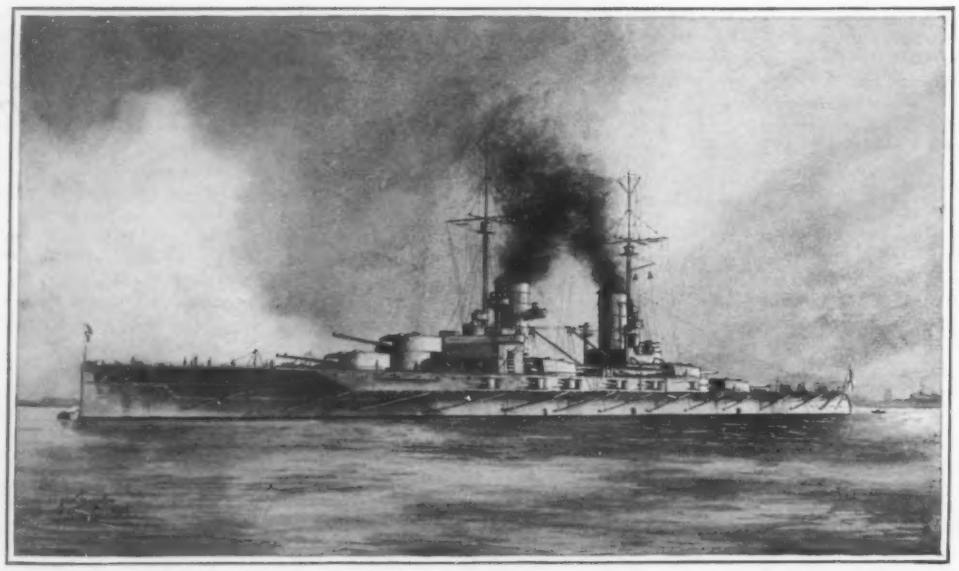
Further, the officer spoke of "four more dreadnoughts" to be completed by the end of 1915. Now everyone will grant that this year will see all the "Koenigs" in commission, but certainly not four additional battleships.

In 1913 Germany laid down two "15-inch gun" ships of the "Ersatz Worth" type, and another during the year following. By all possible acceleration they might just be finished six months under the normal time. This would mean two only being completed in 1915 and one in the following year.



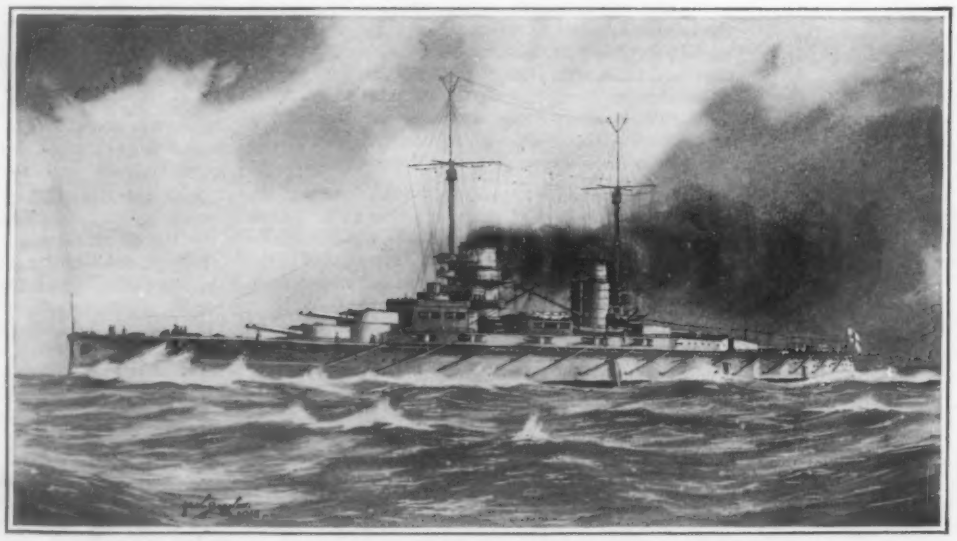
Displacement, 26,600 tons. *Length*, 689 feet. *Speed*, 27 knots. *Armament:* Eight 12-inch, twelve 6-inch, twelve 3.4-inch guns

German Battle-Cruiser, "Lutzow"



Displacement, 25,575 tons. *Length*, 585 feet. *Speed*, 21.5 knots. *Armament:* ten 12-inch, fourteen 6-inch guns

German Dreadnought, "Kronprinz"



Displacement, 19,500 tons. *Length*, 571 feet. *Speed*, 23 knots. *Armament*: eight 14-inch, twelve 6-inch guns

German Dreadnought, "Salamis"

In view of these erroneous statements by the German officer, one feels disinclined to accept his other assertions.

He affirmed that besides the four battleships (of which examination reveals two only) "a number" of battle-cruisers would be added to the German fleet before 1916. As previously stated, the "Lutzow" may well be in commission (but not with 15-inch guns). The next battle-cruiser in order of completeness is the "Ersatz Worth" which was only launched in September last, and it is thus obviously impossible that she should hoist her pennant for some time to come.

The only way in which he could show the least evidence for his "number" of battle-cruisers, is by including the "Salamis," which is another story. This ship was laid down for Greece at the German Vulcan Yard in 1913, and was to be armed with eight 14-inch guns by the Bethlehem Steel Company. Had the American firm delivered the guns and mountings before the commencement of the war, which is questionable, the ship would no doubt be completed. But if not, there would be difficulty in arming her because the German 14-inch guns are fortress guns and have not been mounted in warships hitherto.

Summing up, therefore, this naval officer's astounding assertions, we find that the "Markgraf" and "Lutzow" could not have been re-armed at the late stage he mentioned; that the "four" battleships to be added to the "Koenigs" by 1916 cannot be more than two; and that the "number" of battle-cruisers is reduced to one "doubtful" viz., the "Salamis."

As regards submarines: No one outside the circle of German naval constructors can make any definite statement; but, considering that Germany has devoted enormous energies to this arm, it is quite within the range of probability that since the beginning of the war they may have added sixty to the large number they already had in hand.

Reverting to the "Koenig" type of battleship: as will be seen in the illustration, there is no special novelty in the design, being particularly like the previous "Kaiser" class, except that Germany has adopted the super-imposed turret system fore *and* aft, abandoning the *en echelon* system. It seems strange that the main armament of these ships—laid down in 1913—should be identical with that of the original British "Dreadnought" laid down eight years before, viz., ten 12-inch guns. Such is the German faith in the Krupp gun. The armor, however, is extensive and heavy. Not only has the main belt a maximum thickness of 14 inches, but the funnels are encased in 6-inch armor to a height of 20 feet above the main deck; and a 3-inch underwater skin is fitted for 350 feet amidships. Besides this the designers have provided two conning towers, four special armored fire control stations, and one torpedo control tower.

The "Derfflinger" type of battle-cruiser is a natural

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The Future of Radio Telephony

Significance of the Recent Achievement in Long Distance Radio-Transmission of Speech

By E. H. Colpitts

[It was under the direction of Mr. E. H. Colpitts, the Research Engineer of the Western Electric Company, that the apparatus was developed and the experiments conducted which resulted a few weeks since in the transmission of speech from the Arlington station to Paris on the one hand, and to Honolulu on the other. In view of his intimate association with the most marvelous development of electricity since Marconi sent his first signal across the Atlantic Ocean, Mr. Colpitts can speak with the highest authority on the significance of this epoch-making achievement in radio telephony—ED.]

DURING the past year, the engineers of the Bell Telephone System, ably directed by Mr. Carty, chief engineer of the American Telephone and Telegraph Company, have been enabled to bring to a conclusion studies which gave, first, to America, transcontinental wire telephony; second, to the world, transoceanic radio telephony. These two achievements afford the means of truly universal telephone service and are of very great interest and importance.

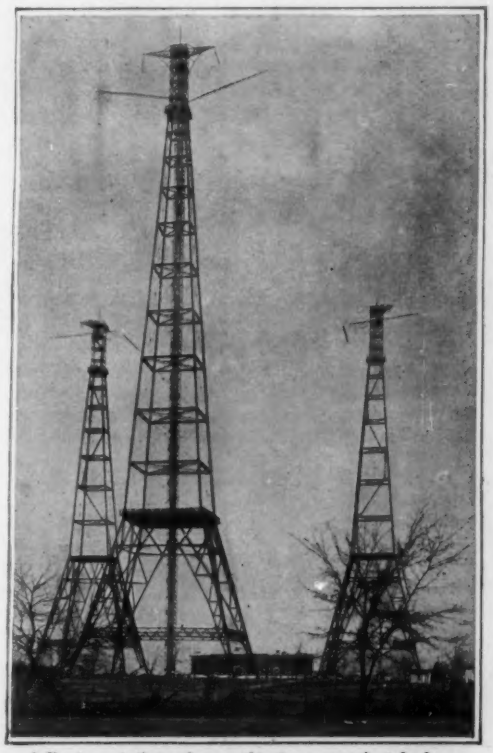
Referring to transoceanic radio telephony, what was accomplished was briefly this: Incidental to a comprehensive engineering study of methods applicable to the art of communication the Bell engineers have recently shown that it is possible to telephone by wireless methods over distances of the order of three and four thousand miles. Further, it is shown to be entirely possible to connect ordinary telephone lines equipped with ordinary telephone instruments to powerful wireless apparatus so that neither the speaker nor the listener need be at or near the radio stations concerned. The radio transmission is secured by using high frequency currents similar to and of the order of magnitude of those used in radio telegraphy for working over similar distances, so that fundamentally the methods and problems of radio telephony may be said to be in large measure identical with those of radio telegraphy.

Even before the advent of radio telegraphy, to telephone without wires had been a dream of inventors and engineers, and certain systems were quite seriously considered. From the early days of the eighties the Bell engineers have kept in touch with the art of transmitting signals through space without wires. Attention was first given to the wireless methods suggested by Bell and others but these proved impractical, and very limited in scope. The later methods of Marconi from the start gave greater promise and were more seriously investigated. Finally the practical solution by the Bell engineers of the problem of extra long distance wire telephony furnished the key to the solution of many problems fundamental to successful wireless telephony, and it was felt by them that the time had come for a serious field study of wireless methods.

As a first step to carrying out these plans, methods had been perfected in the laboratory; then experimental radio stations were established early in this present year at Montauk, Long Island; at the Western Electric Building, New York; at the Du Pont Building, Wilmington, Delaware, and at St. Simons Island, Georgia. Beginning April fourth wireless telephone tests over distances of 225 miles were made in the presence of prominent officers of the United States Army and Navy together with officials and employees of the telephone company. These tests included from the start not only radio telephony between two wireless stations but also the connecting of ordinary telephone lines of very considerable length to both the transmitting and receiving stations. So promising seemed the methods employed that all who observed these tests felt that in conjunction with further engineering work a trial of the methods over transcontinental and transoceanic distances was very fully warranted. In order to obtain certain engineering data the next radio telephone tests were made early in May, between Montauk and St. Simons Island, a distance of about 1,000 miles, which was probably the record distance up to that time. Certainly a new mark was set in talking a distance of 1,800 miles over a combined wireless and wire path, which feat was then accomplished.

The officers in the Navy Department in charge of radio service, in conformity with their policy of aiding by every reasonable means those seeking to advance radio engineering, readily agreed to the telephone company's use of various antennæ suitably located for further experiments in long range radio telephony. During the summer the manufacture of apparatus following exactly the lines of that used in April, but having the necessary power output, was pushed energetically. This was installed at Arlington, Va., where use was to be made of the United States Naval Station antenna. Meanwhile engineers with receiving apparatus were sent to Darien, the Pacific coast, Honolulu and by special courtesy of the French officials to the Eiffel Tower, Paris.

From August 27th on, satisfactory results were obtained almost continuously from Arlington to Darien, thus establishing a record of 2,100 miles. By the last



Arlington station whence the transoceanic telephone message was radiated

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The Eiffel Tower station which heard Arlington speak

of September good results were being obtained to the Pacific coast and the engineer at Honolulu was also advised to listen in. On September 29th, President Vail with other officials of the American Telephone and Telegraph Company talked from his office to Mr. Carty, who was at the station of the United States Navy Yard at Mare Island, Cal. Use was made of a one-way telephone circuit from New York to Arlington, as a connection to the wireless path between Arlington and Mare Island, while Mr. Carty replied over an altogether independent one-way telephone circuit from Mare Island to New York. In addition to his subordinates there were with Mr. Carty at Mare Island various officers of the United States Navy, and others. That same night the Bell engineers transmitted wirelessly from Arlington, speech which was efficiently received at Honolulu by Lloyd Espenschied, a telephone engineer, thus establishing a record for wireless telephony of 4,900 miles. These tests were witnessed at Honolulu by a number of officers of the United States Navy.

Spectacular as this record is, transatlantic telephony makes, however, an appeal to the imagination which transcontinental wireless telephony, even extended to Honolulu, cannot make. Consequently it will ever be a source of pride to Americans that on the days preceding October 20th, American engineers bridged the Atlantic for the spoken word. These words were received at the Eiffel Tower, Paris, which seems most fitting, since, preeminently in France, worthy scientific accomplishment and the fruits of genius are most highly appreciated.

It may be added that at Paris, due to war conditions, the amount of time which Messrs. Shreeve and Curtis, the telephone engineers, were permitted to use the antenna was necessarily very limited. They were therefore at a very great disadvantage, with respect to the selection of the best conditions for successful transmission. This made their success especially gratifying.

Viewed as a more or less incidental step in a broad engineering investigation the actual details of the means and methods which were employed to secure these results assume relatively minor importance. Assuming that it is desirable to employ telephone transmitters, receivers and lines such as are in standard use in telephony and adopting radiating and receiving antennae as essentials of any wireless system, the design of the remainder of the apparatus was not regarded as an end in itself. The actual apparatus employed was merely a more or less convenient tool for engineering research in the broad field of communication. As a fact the methods which were actually chosen and employed grew out of research work carried on in connection with long distance wire telephony. That these methods will be the final commercial methods employed, or even those which will be employed in further experimental work, is not a safe assumption.

This attainment while but a step incidental to an engineering study is, however, of such a spectacular nature as to raise many questions regarding the future field of radio telephony. Due to a broad knowledge of the laws governing electrical actions, the engineer of to-day can with assurance forecast this future as the engineer of a generation ago, who might be called on to forecast the future of a new art, could not do. It is possible to indicate with confidence and in broad terms where the methods of wireless telephony can be usefully employed, where even if physically possible, they must fail to be commercially useful, and where due to essential limitations they cannot meet the requirements of service. The answer to these questions is of interest to all users of the telephone as well as to those who are engaged in furnishing telephone service to the public.

It is seen that even if certain physical obstacles did not intervene, in the case of by far the greater portion of present-day telephone business, operation by wireless would involve prohibitively expensive methods. It is inconceivable to an engineer that the apparatus used at the subscriber's station and the wire plant for connecting it with the telephone exchange will be replaced or even appreciably affected by any wireless developments of the future. As to the wire plant employed to connect exchanges, the use of wireless methods has been urged, especially as a means of replacing the long and expensive toll lines now necessarily employed. In this case, in addition to considering the relative cost of furnishing such facilities one must consider certain limitations inherent in any radio system, and these we may now discuss briefly.

While probably many of the observations are lacking in accuracy, it has been established beyond question, that at certain periods transmission through space is very much more efficient than at other times. This effect is very noticeable when long distances are involved. If this variation were confined to the seasonal variations between summer and winter or even to the daily variations between day and night, it might not prove to be a serious limitation, but as a matter of fact these changes in efficiency seem to occur erratically and quite suddenly. While this difficulty can be overcome to a certain extent where the conditions of

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Strategic Moves of the War, November 24th, 1915

By Lieut. J. B. W. Gardiner, Formerly of the 11th Cavalry, U. S. A.

WHILE the capitals of the Allies have worried and their diplomats have made unceasing efforts to direct the unruly current of affairs in the Balkans more and more Serbian territory has been captured and occupied by the Teutons and the Bulgars. In fact but a small proportion still remains with the Serbians, and as they continue to be driven back, the flanks of the invaders' armies are drawing nearer and nearer together, their battle line becoming denser and denser, and the ability to resist them less and less. Only a small section of old Serbia still remains and it seems inevitable that the Serbian army will be completely broken up, and, driven into the wilds of Montenegro and Albania, will resolve itself into a number of small bands, acting independently. There seems no hope of any other outcome. As this article is being written the Serbs are making what will probably prove to be their last stand, on the historic plains of Kossovo. But it must be evident that such a stand if successful at all can be so only for a short time. The fact that they are fighting on a short line is of course to their advantage. But the disparity in numbers is too great, and the Serbs, in probably not more than two weeks time, will see all of their country except the newly old and new will have to be abandoned to the Teutons and the Bulgars. There is no possibility to enlist Greek aid. In fact it would be suicidal for Greece to declare for the Allies at this juncture. The time has gone by when her assistance would have solved the Allies' problem. Now Greece finds herself with a strong Bulgarian force almost immediately on her border, and a still stronger force of Teutons and Bulgarians advancing from the north and not so very far distant. To declare for the Allies now would simply be to invite invasion by a force, which, even with the assistance of the Allies, Greece would find it impossible to repel.

As time passes it grows increasingly difficult to understand just what this invasion of Serbia portends. The gateway from Berlin to Constantinople is open, it is true, but then what? Lack of transportation facilities and the long line of communications that would have to be guarded makes an operation against Egypt almost impossible. The Teutons, even with such assistance as the Turks can give, cannot hope to hold another line over fifteen hundred miles long. Turkey cannot feed Germany. Her crop of cereals is but little more than sufficient to support her own population. Bulgaria of course, has in storage two years' wheat crops, but natural. There has been nothing in these fields to appeal to the imagination, surfeited as it has become with startling, dramatic victories, first of one side, and then the other. The Italian advance has been slow, painfully slow to those who, not realizing topographical conditions nor the defensive possibilities of the Alps and Dolomities on the west or the Isonzo on the east, felt that as soon as Italy threw down the gauntlet her troops would fight their way steadily and without delay to Trent and Trieste. But the mountains of Trentino have always been regarded by the military men of Europe as an insuperable obstacle, effectually preventing any offense and of themselves constituting at least 75 per cent of Austria's defensive strength against an attack coming from either east, west or south. This is readily apparent to anyone who has passed from Geneva, Lausanne or Basle in Switzerland through Trentino to Milan, Venice or Brona. The valleys are narrow, so narrow at times that the railroad right of way passes on rock ledges cut into the mountain sides. The sides of the mountains are almost perpendicular and their snow-capped tops like an irregular mass of rough, jagged, gigantic teeth projecting upward into the skies. In such a country an effective connected in-

Bird's-eye view of the Austro-Italian battle fields in the Alps

gained Macedonia, pass from them. Already the Teuton line extends parallel to the Montenegrin frontier, from Prjepalje to Novo Pasor, and from there to Lesowatz, and in the Tetowo district it extends, after coming down the railroad to Uskub, almost to the Albanian frontier. From Uskub to the Katschanik Pass the railroad of the Iban valley is entirely in Bulgarian hands, thus barring the retreat of the Serbians into Macedonia and preventing the Allies in Macedonia from sending help north. Just why the Allies delayed so long in sending help, why the Serbs were all concentrated in the north while the vital part of the whole defensive scheme is the railroad in the south from Saloniki to Uskub, will probably always remain a mystery. It is openly hinted, that it is because of a secret understanding with Constantine whereby he was to add 150,000 Greeks to the Allied armies as soon as an equal number of French and British had landed at Saloniki, which understanding the Greek king has disregarded. The result is that not only are the troops in old Serbia doomed, but the French and British forces in Macedonia are unable to hold their own with the increasing numbers of Bulgarian troops. By the capture of Babuna Pass, the French line along the border has been outflanked and at some points has been forced back. It seems inevitable that all of the Allies will be driven across the Greek frontier and that Serbia, and this is now available to Germany—at a price. But this latest move puts an added drain not only on German reserves, but on German finance, and Germany has already borrowed more money for this war than all the Allies combined. It is difficult, then, to see anything else in the Serbian invasion than a political rather than a military undertaking, which has for its object the creation of a sentiment throughout the world that Germany is invincible, that there is no military undertaking the German armies cannot accomplish. And then will come talk of peace. There can be no question but that Germany wants peace and needs it. To face a winter in her present position in Russia, with the Czar recruiting new millions from his inexhaustible reserve, accumulating a greater supply of ammunition than he has yet had and organizing and welding his enormous resources is a picture not pleasant for Germany to contemplate. Conquering the Serbians will add no comfort when the spring comes. It would surprise no one, then, when a decision has been gained over the Serbs, and it undoubtedly will, to see the press of the neutral world filled with hints and suggestions of peace, carefully placed by the German Publicity Bureau.

So completely has public attention been absorbed in the tragedy of the subjugation of Serbia to Teuton arms, that the operations in the Italian theatres—in Trentino and in Carso, have received but scant attention. This is vasion is obviously impossible and Italy has of course never attempted it. Her problem did not demand it. On the north and in part on the east also, as well as on the west, Italy is practically hidden from the rest of the warring nations by the same sort of a screen of almost impassable mountains. These mountains open into Piedmont, Lombardy and Venetia by means of passes through which troops invading any one of these provinces must come. It is only in the southeastern part of the Province of Venetia, along the lower Isonzo, that the country opens up sufficiently to admit of military operations on a large scale. It is here therefore, with Trieste as the objective, that the great Italian offensive has been launched.

Before, however, such a move could be pushed the Austrians who were in the Trentino in force, had to be neutralized. Otherwise the Austrians would pour through the mountain passes directly on the flank and rear of the troops on the Isonzo line. This part of her task Italy has accomplished with great thoroughness. As far as their ability to invade Italy is concerned, the Austrians in Trentino might just as well be fighting with the Germans on the Gulf of Riga. Every outlet from Trentino has been effectively closed.

Beginning on the west, where the Trentino boundary joins that of Switzerland, these outlets are the Stelio

(*Concluded on page* 507)

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Navy and Mr. Kitchin

To the Editor of the SCIENTIFIC AMERICAN:

One of my sons has called my attention to what I think is one of the best editorials which has appeared in your paper ("Rehabilitating the United States Navy" issue of October 30th) regarding the necessity for quick and effective action in our program for naval preparedness. I think it would be a good plan to have this rewritten and printed in the form of a pamphlet so that it can be sent to every member of Congress at the opening of the session. Your suggestions are certainly very timely and full of common sense and should appeal to all thoughtful men. It might be well to have the National Security League and the Navy League distribute this pamphlet wherever they think it might do the most good, but certainly every member of Congress should have a copy of it.

In the New York *Sun* of November 19th Representative Claude Kitchin, Democratic leader of the House, is quoted as having said the following in a speech at Scotland Neck, North Carolina, on the previous day—"Our navy is twice as large as Japan's and is far superior to that of Germany." Feeling that it was an outrage that a man occupying as prominent a position as he does should be allowed to mislead the people on such an important subject, I addressed a letter to him a few days ago which you have my permission to print in connection with this letter, if you see fit to do so, for I think he should be compelled to produce his proofs or be made ridiculous. It is unbelievable that a man occuying his high public position should talk and argue as he does. The letter is as follows:

"November 22nd, 1915.

"*Hon. B. Claude Kitchin, House of Representatives, Washington, D. C.*

"DEAR SIR: As one who was born in North Carolina and who has always cherished a great love for that State and her people because his ancestors lived and worked there for more than a century, I feel that if you are correctly quoted in the New York *Sun* of November 19th as having said at Scotland Neck the day before that our navy is 'twice as large as Japan's and is far superior to that of Germany,' I am only performing a public duty in correcting the wrong impression which you would create among the people of the Old North State and elsewhere. It seems to me that you are far exceeding your privilege as the acknowledged leader of the Democratic Party in the National House of Representatives when you make a statement like this which is so glaringly incorrect. Germany has 27 battleships of the dreadnought class and battle cruisers, besides those authorized since the war began. Moreover, she is undoubtedly building those authorized much faster than we are doing. We now have only 10 battleships of the dreadnought class and five building and two authorized, a total of 17 ships of the first-class when those which are building and authorized shall be completed. As the rate of building is much slower in this country than in Germany, she will probably have several more dreadnoughts before all of ours are completed. No fancied superiority of ours in ships and men could make up for their superiority in numbers. It is a matter of common knowledge among the civilians of America who have taken the trouble to inform themselves on this important subject, that Germany's present navy is acknowledged to be much stronger than our navy by all of those whose opinion as to the fighting value of ships has any real value.

"Also it is not true that our navy is twice as large as Japan's, if by that you mean in fighting power. I challenge you to produce the proof of the correctness of the statements which you are reported to have made. If you are correctly reported it is clearly highly improper that a man occupying your public position should knowingly try to mislead the people who have elected him and who are trusting him to vote for them on the momentous questions which will arise at the next session of Congress. If you do not know the facts in the case it is because you have not taken the trouble to acquaint yourself with them, which most people would think it your duty as a public man to do. You are entitled to whatever opinion your intelligence may cause you to have on the subject of national preparedness against attack by a great foreign power, but you are not entitled to misrepresent fundamental facts and deceive the people of your State, when by so doing you are lulling them and others as well into a state of false security."

The facts cannot be blinked, and these facts are, unfortunately for us, far better known to the governing and directing class of Germany and other nations than they are to our governing and directing class—the American people. After all does not our greatest menace lie in the ignorance of a great portion of our people?

DANIEL MOREAU BARRINGER.

Philadelphia, Pa.

Action of Acetylene on Metals

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of November 6th, 1915, there is a reference to an article which appeared in the *Chemiker Zeitung*. The article had to do with the effect of acetylene on metals.

As you will recall, the statement was made that "a minute examination showed that there was no formation of acetylene-copper, since the substance formed could not be exploded either by heat or by percussion." It is the cencensus of opinion throughout the world that acetylide of copper is frequently formed where acetylene under practical conditions comes in contact with copper, and the rules and regulations of all regulative bodies forbid the use of copper for this reason. The article goes on to say "the same result was obtained when a copper tube was employed to conduct acetylene. The tube became stopped up while in use. The black powder which was scraped out of it had no explosive properties." The fact that the copper tube became stopped up with the generative products would be enough, but the article goes on and says, "because of the above results, the authors advise the use of copper and its alloys in the installation of acetylene plants, since this precludes the danger of explosion." This is evidently a complete mistake. The digest of this article which you have just sent me ends with the words "copper and copper alloys should hence be avoided in acetylene apparatus or be coated with tin rather than with nickel."

When the original article came out, I brought it to the attention of the Technical Committee of my association, but your letter enclosing the abstract came before their report arrived. I believe that the inadvertent recommendation that copper be used in the installation of acetylene plants is an extremely hazardous recommendation, and that some steps ought to be taken to correct it.

A. CRESSY MORRISON,
Secretary.

New York.

Sponson Mounting for Guns

To the Editor of the SCIENTIFIC AMERICAN:

In your latest issue I notice a photograph of our latest capital ship, the "Nevada." I also notice that the 5-inch guns present the same dangerous defect in the manner of their mounting as preceding ships have presented, *i. e.*, the pivot on which they turn is so far back of the armor that the port hole has to be almost as high as the distance between decks and apparently 10 feet wide. This leaves the gun crew exposed to the fire of every gun of the enemy, unless, perhaps, machine gun fire, while the gun and the deck behind it are wholly unprotected. A good many years ago I suggested to the Navy Department the mounting of the gun in a sponson, the pivot of the gun mount being exactly on the center line of the armor. With a sponson of a little over 2½-foot radius a gun measuring 18 inches through its thickest part, which I presume to be about the dimensions of our 6-inch gun, would have a range of fire of 135 deg., an elevation of 22½ deg. and a depression of about 5 deg., yet the port hole would be only 5½ feet wide and 3 feet high—indeed a close calculation might take half a foot off this height. In this way the guns forward and aft could be trained all the way from dead ahead of aft to 45 deg. abaft the beam—a greater range of fire, I venture to think, than any of them now have. Of course, if a less range were considered sufficient, the size of the port hole and of the sponson too could be diminished accordingly. And if a circle of 5½ foot diameter is not sufficient for the gun mount, the radius of the sponson could be increased, without necessarily increasing the size of the port hole.

Chicago, Ill. T. W. BROWN.

Vladivostok Open All the Year

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of August 7th in an article entitled "Connecticut to Poland by Way of the Pacific" there were several misleading statements regarding the port of Vladivostok and the Siberian Railway: this article has been brought to my attention by an official of this city, and as it has caused some annoyance and may even be the cause of financial loss to firms engaged in business through this port, I would suggest that the following corrections be made.

Vladivostok is not "icebound for three fourths of the year, and usually accessible only during the months of July, August and September"; it has not been closed to shipping for several years past, the channel being kept open by ice-breakers during the time the harbor is actually frozen over, which is only for the period from the latter part of December till the end of March.

The Amur Railway does not "lack 600 miles of completion," but is entirely finished with the exception of the long bridge at Habarovsk and one smaller bridge; neither of these breaks in the line interfere seriously with the use of the railway for the transport of government freight, as during the summer it will be taken across by ferries and in the winter by sledges, it being even possible that the track will be laid across on the ice during the coldest part of the winter. The stations and other necessary buildings will be completed within the next two months and then the regular transport of private freight will begin, though at a rate somewhat higher than will be charged after the bridges are completed. The doubling of the track between Vladivostok and Nikolsk-Ussurisk is being completed and as soon as this is done there will be a complete double track from the Pacific to European Russia by using the Ussuri Railway from Vladivostok to Habarovsk and thence the Amur Railway to its junction with the main line near Chita, east of Lake Baikal.

J. K. CALDWELL,
American Consul.

Vladivostok, Siberia.

Accident Cases Reported by Gas Companies

To the Editor of the SCIENTIFIC AMERICAN:

The following is a rather interesting analysis of some 6,200 employe accident cases reported by 119 gas companies located in 35 states, and I am sending it to you in the thought that it may be useful to some of your readers:

	Per cent
Leakage of gas, inside	1.62
Leakage of gas, outside (including 3 fatalities)	1.03
Animal bites	1.75
Machinery in operation (1 fatality)	2.63
Elevators (2 fatalities)	2.19
Explosions, ignited gas, etc. (3 fatalities)	3.01
Falling in or through openings (1 fatality)	4.23
Hot material (1 fatality)	4.88
Objects, hanging or swinging	.75
Objects, protruding	4.36
Objects, falling (1 fatality)	11.29
Flying particles	7.87
Vehicles (3 fatalities)	8.69
Nails, wires, etc	6.53
Handling of material	9.73
Slipping or tripping	8.93
Hand tools used by injured	12.80
Hand tools used by fellow employe	2.19
Miscellaneous (1 fatality)	5.52

It will be noted that with but few exceptions the hazards met in the operation of gas works are those met in other industrial plants, and that but 5.66 per cent of the total cases received were peculiar to the gas industry, these cases being due to: Leakage of gas, inside, 1.62 per cent; leakage of gas, outside, 1.03 per cent; explosions, 3.01 per cent.

This information is included in a report I have made as Chairman of the Accident Prevention Committee of the American Gas Institute, which report was presented at the annual meeting in San Francisco several weeks ago.

JAMES B. DOUGLAS.

Broad and Arch Streets, Philadelphia, Pa.

The Current Supplement

THE charming picture on the front page of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2083, for December 4th, 1915, is a scene taken in the Rocky Mountains, and is one of several illustrating an interesting article on *Parks in the Canadian Cordillera*, which describes Canada's beautiful public play grounds. *TheRelation of Phrenology to the Study of Character* tells about the self-deception and shallow psychological notions of former times. *Communication with Aircraft* describes some of the methods used for signalling that have been employed in the war in Europe. *The Progress of Surgery* tells of military medical service in ancient times, and is profusely illustrated by pictures showing operations and instruments employed. There is a short article on *Trench Frost-Bite*, which describes the difficulties encountered by the soldiers in the trenches in Flanders as a result of cold weather. *Massage in the After-Treatment of Wounds* covers a subject that is of rapidly growing importance in Europe. *Faulty Fabrics* describes some of the manufacturing processes that result in imperfect cloths, for which the laundryman often gets the credit. It is of practical interest to every family. For the electrically inclined there is an unusually valuable article on *Designing Small Dynamos and Motors*, that fully explains the theory, and gives full instructions for winding. *Turbines vs. Engines in Units of Small Capacities* discusses a question of considerable importance in manufacturing, or elsewhere where power is used. The article on *Potassium Photo-Electric Cells* is concluded, and there is other valuable matter.

The Passing of the Steam Locomotive

Railroad Electrifications of Marked Importance

By Charles B. Brewer

As noted recently in the SCIENTIFIC AMERICAN the Pennsylvania Railroad, in September, inaugurated an electric train service over that part of its "main line" between Philadelphia and Paoli, on a stretch of its four-track road carrying fast through trains between the East and the West and hauling almost the heaviest traffic of any railroad in the world.

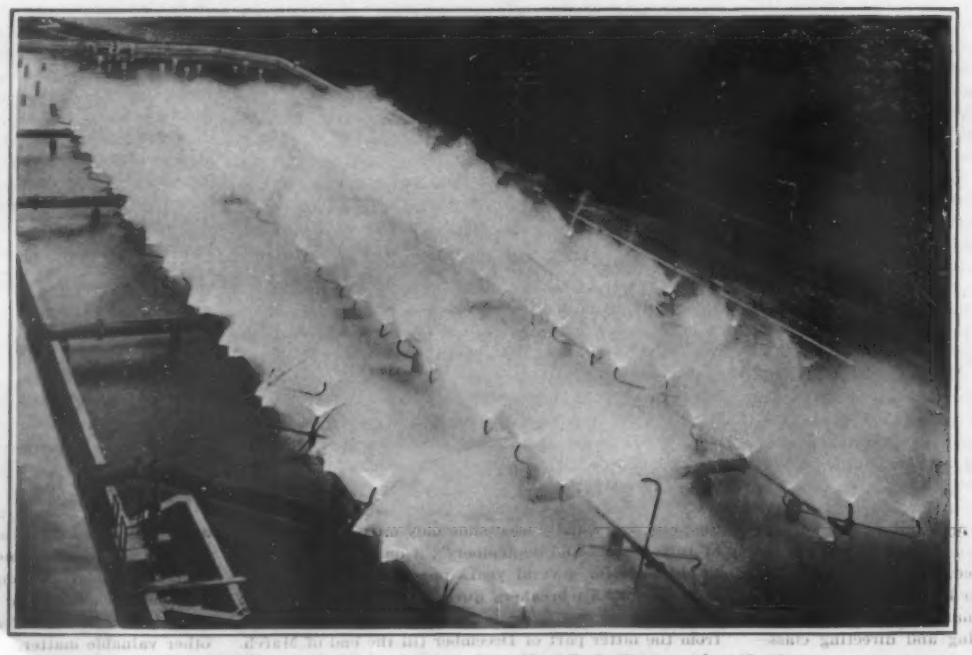
Another recent and even more significant instance of a great railroad, operating in close proximity to the coal fields, abandoning a part of its coal-burning equipment in favor of electric traction is that of the Norfolk and Western Railway on a division between Bluefield, W. Va., and the coal mines.

Heretofore special conditions have dictated the substitution of electric for steam locomotives, such, for example, as in the case of the Baltimore and Ohio Railroad, the first main line railway, by the way, to adopt the electric locomotive. There the problem was to avoid the smoke and gas in its Baltimore tunnel. The Hoosac Tunnel in Massachusetts, the Pennsylvania's approach to New York city under the Hudson, and the Great Northern's tunnel under the Cascade Mountains were doubtless dictated by similar reasons. The New York Central and the New York, New Haven and Hartford Railways were forced to electrification by legislative action, as a result of a serious collision in the tunnel leading into Grand Central Station, New York city. Other notable examples of electrification are at the St. Clair and Detroit Rivers, for railroads between the United States and Canada. Both installations are in tunnels. Typical examples of electric installation to secure the advantages of frequent service and short trains for suburban and interurban traffic are the Pennsylvania's West Jersey Road between Atlantic City and Philadelphia and the lines of the Long Island Railroad.

The reasons for adopting electrification on the Pennsylvania's "main-line" and on the Norfolk and Western Railway were, however, influenced by problems which constantly confront the railway officials of almost every system. Here we see, in one case, the steam locomotive supplanted dangerously near the heart of the Pennsylvania coal fields, and in the other case, at the very mouth of the West Virginia mines. No question of the utilization of water power entered into consideration in either case. Both receive power from boiler installations.

Electric locomotives on the N. & W. R. R. hauling heavier trains at twice the speed formerly obtained from steam locomotives

Snowdrift on the Des Moines and Southern 1200-volt direct-current line



Spray cooling pond for condensing plant, Norfolk & Western electrification

Might it not be well to ask: Who shall be bold enough to prophesy how long the roar and puff of the steam locomotive will be heard? And, especially, how long will they be heard in the great West, where coal is hauled hundreds of miles to mock the great water-powers along which it steams?

Steep grades and a heavy freight traffic dictated the change on the Norfolk and Western road. Because, under steam operation only 7½ miles per hour could be made by its freight trains with two locomotives and a "pusher," steam has given way to electricity. The new electric engines haul heavier loads at twice the speed over the steepest grades and nearly four times the speed over other parts of the run.

Yet many of the grades in the West are almost twice as heavy as those where this electrical installation has been called in to solve the problem of heavy grades. Two engines are used every day on grades on many Western roads for short passenger trains. The writer was recently a passenger on a train in the West where three locomotives were required for 14 cars, and saw a photograph of the Denver and Rio Grande Railway using five locomotives for 11 passenger and mail coaches. One of the principal divisions of this road parallels the beautiful Gunnison River for over 100 miles, in which distance there is a drop of nearly 4,000 feet. And the volume of water in this river is so great that the Government in an irrigation project, diverted a part of it to feed another river by tunnelling 6 miles under the mountains.

Electrification requires large sums of money. The Government's conservation policy, too, has been blamed for the slow development of water power in the West, and Secretary Lane in strongly advocating the Ferris Bill, states that development will not take place until a law is passed which will give such promise of safety to the investor as a reasonable man may ask.

The Electrification of the Norfolk and Western Railway

The steam locomotive which has been supplanted on the Norfolk and Western Railway is the famous "Mallet" compound type with mechanical stokers and superheaters; the last word of the locomotive builder.

The new Baldwin-Westinghouse electric tractors

are the most powerful locomotives in the world. They weigh 270 tons and have a guaranteed horse-power of 6,700. Experience with them has shown a continuous output of 8,000 horse-power, and, while the trains are being accelerated the motors develop as high as 11,000 horse-power. The fact that the heavy express trains of the New York, New Haven and Hartford are hauled by 100-ton locomotives, which, when running 60 miles an hour develop only 1,500 horse-power, illustrates the tremendous advance in the power of the Norfolk and Western electric tractors.

One of the unique features of the Norfolk and Western installation is the use of the three-phase motors from a single overhead wire. By using the three-phase motor the locomotive can hold or brake the trains at constant speed while descending the grades, and utilize the energy by returning it to the line and making it available for any other train on the road. This is the first installation of the kind except on the line at Giovi, Italy. At Giovi, however, the trains are only 400 tons and on the Norfolk and Western they are 3,250 to 4,700 tons. Italy has been very quick to adopt advanced practice in electrification. An Italian railroad first followed the lead of the Baltimore and Ohio Railroad in the use of electric locomotives in 1895.

The advantages gained by the Norfolk and Western's electrification have been pronounced. Formerly two "Mallets," with a pusher at the grades, handled the trains at 7½ miles an hour and required *four* hours for the trip. One electric tractor, which also uses a pusher at the grades, now handles much heavier trains at 14 and 28 miles an hour and makes the trip in less than *two* hours. So far the electric tractors have handled 75 loaded cars with ease. It is the intention to increase the number until the limit is reached. An enormous draw-bar pull of 180,000 pounds has been recorded.

Electrifying a Stretch of the World's Busiest Tracks

Peculiar interest attends the work completed by the Pennsylvania Railway, which will give it the most modern and efficient 20 miles of electrified railroad in the world.

The work has cost about $4,000,000—a sum sufficient to buy a right-of-way and build 400 miles of ordinary track.

Every step has been taken with the care and precaution characteristic of the railroad which recently operated 68,444 passenger trains in a single month, and brought in 91 per cent of them on time, and during 1914 hauled over 180,000,000 passengers and lost the life of no single one of them.

While there will be a slight money saving to the company and while the public will receive a faster, pleasanter, and more frequent train service, the primary object of the change was to increase the traffic handling arrangements of Broad Street Station, Philadelphia. This station is known as a "stub" terminal. Every one of the 506 trains which daily arrive and depart from it can not leave until a fresh engine, headed in the proper direction, backs in from the yard to what was previously the rear of the train. After the train departs the first engine must back out to the yard and be reversed on a turntable. If any change is to be made in the train a switch engine must back in, haul the train out, break it up, remake it and back it in to the station. From four to eight such movements of trains and engines are necessary for every train arriving and departing. To reverse an electric car, or an entire electric train, the motorman simply walks from one end to the other. The greatly lessened time which the train occupies space in this crowded station will also be of no small importance.

There are 19 stops in the distance of 20 miles, and a local train running with steam power, even though hauled by the heaviest of steam locomotives, is practically starting or stopping throughout the entire run. With electrification of the type adopted, each car has its own motor and a long train gains speed as fast as a single car.

Experience of Various Railroads

The Michigan Central Railroad installation at the Detroit River tunnel, connecting its tracks in the United States with those in Canada, has saved much time, prevented many delays, and avoided troublesome fog and ice conditions formerly encountered with its ferry service. Under the old conditions each ferry boat required 30 minutes to load, unload and make the crossing. The average capacity of each boat was 18 freight cars, so that three, and often four, ferry boats were required for many of the trains. Under the new conditions a train of any practical length and weight can be handled through the tunnel in less than six minutes.

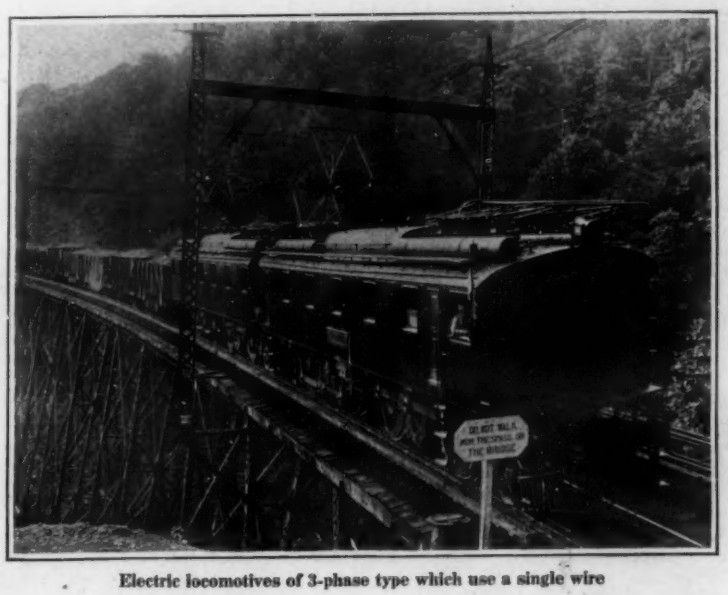
An official of the New York, New Haven and Hartford Railroad has stated that that road's experience shows the upkeep cost of its electric engines per 100 tons of weight is five to seven cents per mile against 8 to 25 cents for the steam locomotive, dependent on kind of coal and water used. He also stated that a pound of coal under the boilers at the central electric station develops twice the draw-bar pull as if burned in the fire box of a steam locomotive.

Careful records by the Pennsylvania Railroad for four years show that 33 electric locomotives used during that time at the New York terminal, have totaled 3,974,746 miles. A number of individual engines have run from 90,000 to 112,000 miles before any general repairs were necessary, and the total train detention due to engine failures has amounted to but 4½ hours during the four years time.

Courtesy of General Electric Co.

View on the Butte, Anaconda & Pacific Railway before electrification

Train of copper ore, 65 cars, 4550 tons, on the Butte, Anaconda & Pacific Railway



Electric locomotives of 3-phase type which use a single wire

The Butte, Anaconda and Pacific Railway handles much heavier trains electrically than those formerly hauled by steam. The speed is also nearly twice as great. The freight movement is one of the heaviest in the world; yet owing to the increased train weight and schedule speed, night work has been greatly reduced, and at the same time, a larger tonnage hauled than ever before. The current is purchased, and added to the other advantages, about $200,000 per annum is saved in the cost of the current compared with the former coal bills.

The Chicago, Milwaukee and St. Paul Railway now has about 85 miles of its road electrified. Work is under way to electrify 440 miles additional. Trains will be heated by steam from oil-burning boilers. The saving on coal bills is expected to amount to over $1,000,000 a year.

Electricity is extensively employed in other countries. In Switzerland, where there is no coal and many water powers have been developed, it is used on many lines, and the Government, last year decided to so operate all the lines of the Swiss State railways. Three important projects are under consideration in India and work has very recently been completed in Sweden on 70 miles of the most northerly railroad in the world, between Kjeronavare and Narvik, which extends 130 miles within the Arctic Circle. This railroad has reported an increase of 40 per cent in the weight of its trains and a 50 per cent increase in speed by the use of electricity. When the power plants at Daleff and Porjas in Lapland are completed they will supply the power to the State railways of Northern Sweden.

The latest system of electrification will be used to operate the trains through the new Canadian Pacific tunnel near Glacier, B. C. This tunnel will be the longest railroad tunnel on the Western Hemisphere, except one for the unfinished "Moffat" road in Colorado. It is just 5 feet over 5 miles long. It cuts down the grade over 500 feet, shortens the route 4½ miles and eliminates 4 miles of snow-sheds which cost about $100,000 a year for maintenance. The engineering work of the undertaking forms a most interesting story of itself.

A work of great importance is also under way at Melbourne, Australia. The change affects 289 miles of track and involves an expenditure of over $10,000,000. Though provision is made for handling upwards of twice the number of passengers and also increasing the speed of the trains, the change will affect a saving of about $500,000 a year in operating costs. Originally 1917 was set for the completion of the work, but the General Electric Company, which is supplying 400 motors for the service, states it is so advanced that it will be in operation next year.

The eyes of the railway world are centered on these recent installations, and as this is written, arrangements are being completed for a special tour of inspection over the Norfolk and Western by ninety of the leading railroad officials of the country. Those looking for momentous signs in these stirring times will do well to closely watch the effect of these recent electrifications.

Preserving Milk Powder

A METHOD has lately appeared in Europe for preserving various food or other products, and especially milk powder, the idea being based upon placing the substance in a sealed vessel or packing case with inert gas, so that this latter prevents the usual spoiling of contents by the action of the air. In the French patented process, the milk powder is packed in metal boxes of convenient size which are entirely sealed except for a pinhole that is left at the top. A number of such boxes is put in a chamber and the air is exhausted by means of an air pump. When this operation is finished, valves are opened which allow nitrogen to enter the chamber and fill up the several boxes. Then opening up the chamber, the boxes are quickly removed and the pinhole soldered before an appreciable amount of air has time to enter. In this way the contents of the boxes are kept in an atmosphere of inert gas, and the process is most practical from an industrial standpoint.

Future Possibilities of Electricity

Some Sources and Applications That Await Development

By Carl Hering

ONE way to prophesy what electricity will do for mankind in the future would be to allow oneself to have a pleasant dream, as it is only while dreaming that one is not hampered by the discouraging restrictions which are so often met with in practical work while one is awake, and which have so often and so rudely crushed the hopes of the dreaming inventor. The purpose of the present article, however, is not to record a proposed dream, but to limit this prophecy to such of the future possibilities of the application of electricity as we have some good ground for believing will or may be accomplished, sooner or later.

In many cases nature has shown us that certain greatly desired things or processes are possible. This is always the first and very important step in a problem, as it shows that a solution exists. It is therefore for us to find out how nature does it and then to devise, if possible, a practical method for doing it. And there are other things that our present knowledge points to as not only possibilities but probabilities. It is therefore not necessary to go into dreamland for attractive prophecies. There are, moreover, other things about which we are able to prophesy with safety that we need not look forward to as possibilities.

It is a very sure prophecy to say that, when electrical energy is sold much cheaper than it is now, many things will be done with it, which though possible now, are not practicable on account of its present cost. So numerous are the applications of electrical energy that a great reduction in its selling price would so greatly increase the consumption that the smaller profits per unit on a far smaller consumption. So vastly great would be the applications of electrical energy to the benefits of mankind and to the development of commerce and industries, that it may well be possible that in the future the government will supply electrical energy at cost or even less. The great development of this country which has been due directly to the government postal service, supplied to us at cost, might well be duplicated if not exceeded by a similar government service in the supply of electrical energy at cost.

It is true that the power from waterfalls, winds, tides, sun's heat, etc., is cheap because it costs nothing in its original form; but to be available for general purposes it must be harnessed and distributed to consumers, and the cost of doing this is in many cases even greater than to buy the coal from which power is so easily obtained. Hence the possibilities in these directions lie entirely in the development of simpler and cheaper ways of harnessing these gifts of nature; but the outlook for great progress in this direction does not seem very hopeful, at least at present.

The almost unlimited source of power residing in the rotation of the earth, and in the movement of the moon, are also attractive possibilities. The latter would be accomplished, in part, by the utilization of the power of the tides, which in fact is largely "moon power." And theoretically at least the gyroscope might be a possible means for making available the power of the earth's rotation, as it does not require the otherwise very necessary fixed point in space. But in either case the prospects of the harnessing of this free power at a reasonable cost are so remote that they need not be considered here. As the magnetic field of the earth probably rotates with it, the production of electric power directly by the rotation of the earth is, no doubt, theoretically excluded.

The great and promising future for electrical energy lies in two of its properties; one is that energy or power is more easily and more conveniently transmitted over great distances and locally distributed, when it is in the form of electrical energy, than in any other; and it may be said to be the highest form of energy, as it can be most easily converted into all other forms. Energy in the form of heat is the other extreme, as it is the lowest or least available form for conversion into other forms than heat.

The real art in dynamical engineering is to convert the lower forms of energy into the higher ones—by higher being here meant those that are more easily utilized for the benefits of man. A most desirable achievement, therefore, is to convert the lowest form, heat, directly into the highest, electrical energy, instead of indirectly by means of the steam engine. This is known to be possible, as for instance by means of the thermopile. It is also possible to convert the heat energy of the air into electrical energy by means of a battery based on a physical action which develops cold, hence absorbs heat from the air and delivers the energy thus obtained, in the form of an electric current, as was shown by the writer many years ago. While neither of these methods is now practicable on a large scale, they at least show us that such direct conversion is a possibility, which is the first step; the problem of the future is to devise means for doing it on a practical scale, but the present prospects of accomplishing this are not great.

The much-talked-of carbon battery, in which carbon is oxidized in a battery to produce electric energy directly, has apparently made no progress, nor are there prospects for its success. A more probable solution of this problem would seem to be a two-step process in which the energy of the carbon is first converted by some efficient process into some form of chemical energy stored in a solid, liquid or gas, which can then be used in a battery. Many years ago the writer made a battery in which the materials consumed were illuminating gas and air, the former being oxidized by the latter at room temperatures, giving its energy as an electric current; but it merely showed the theoretical possibility as it was not a practical apparatus. All forms of batteries as electric generators are moreover so cumbersome that at best they could be used only for small powers.

The human body shows that it is possible to oxidize carbohydrates, namely the foods we eat, into the oxides of carbon and water, at practically cold temperatures, and obtain mechanical energy from them in a useful form. Probably this conversion of chemical into mechanical energy is accomplished at a high efficiency, which is moreover apparently not governed by that vexatious thermodynamic law which so seriously limits the best possible efficiency of the steam engine, on account of the remoteness of the absolute zero of temperature which governs it. When the physical chemist can tell engineers the process by which carbon compounds are oxidized in our bodies, the possibility is opened for the engineer to devise means for doing it on a large scale by means of artificially constructed apparatus, and when this can be done on a commercial scale, our present wretchedly inefficient steam engine will be relegated to the museums as an illustration of our present ignorance.

There are many cheap carbohydrates rich in chemical energy, but which cannot be digested as foods, yet we are told that a mere rearrangement of their atoms would make them digestible. The fungi known as mushrooms and toadstools, which are not real plants but mere saprophytes, seem to produce this rearrangement of the atoms without the use of sunlight; if so, nature has here again shown us what is possible, and it remains for us to find out how it is done, thereby making available a lot of new food materials. Possibly electricity will be found to be the means of doing this.

The application of electricity in some form for the stimulation of plant growth, and for the beneficial action on animal organs, has apparently not received the attention of scientific investigators that the possible outlook deserves. If by some such artificial stimulant two crops could be raised during the year instead of one, it would, of course, be of immense value.

The sun's rays were formerly considered to be mere light and heat rays; it will probably be found that they are much more complex, containing also other forms of rays not yet studied, and when they are and their useful applications have been found out, it is quite likely that they could be produced artificially and most probably by electrical means. It is known that the sun's rays have a germicidal action and are healthful. If the particular rays which accomplish this can be singled out and produced artificially very useful applications would be possible.

A number of different forms of rays heretofore quite unsuspected, have been discovered. It may be that there are many more, and they may be found to have other very useful properties than those of the X-rays and ultra-violet rays for instance. When these have been studied, it is quite likely that electrical energy, which has already shown itself to be the most available of all forms of energy, will be used to produce these desired rays. That very rare and highly expensive metal, radium, gives off several rays, one of which is claimed to have important curative effects. A study of these rays may show that they could be produced electrically, thereby making us independent of this extremely rare material for that purpose.

Radium is known to set free energy; hence a reversal of this process, that is, a corresponding storage of energy, would seem to be at least a theoretical possibility; this would be of incalculable value, if practicable, and if it is ever done, it is likely that electricity will be the medium. It may be possible that under electrical stimulation other materials than radium might be made to give useful radiations.

The firefly is another case in which nature has shown us that the production of light without heat is possible and that light can be produced with extremely small amounts of energy. At present we are wasting about 98 horse-powers of energy to get about two horse-powers of light in the usual forms of electric incandescent lamps, hence (if this is correct) there is a possibility of producing nearly fifty times as much light from the same power. And as our steam engines give us only one sixth of the energy in the coal, there is a further possibility of six times this, or nearly 300 times the light now obtained electrically from coal.

Radiant light is known to differ from the radiations produced for wireless telegraphy only in that the frequency of the waves is very much higher, that is, the wave lengths of light are vastly smaller. It is therefore only a matter of degree and not of kind, to produce light radiations as directly as the radiations for wireless are now produced, that is, without first producing high temperature heat. As they merely differ in frequency, a frequency changer would be a possibility of changing the low into the high frequencies; luminescent materials are such frequency changers, but they all seem to act to reduce the frequency instead of increasing it.

The light of the future will probably be from large surfaces of low brilliancy; with less brilliancy of the source, the pupils of the eye expand, hence we then require less light to see by.

Perfections of the electric furnace will no doubt enable it to replace many of the fuel furnaces, notwithstanding the generally higher cost of the heat; a better product, chemical cleanliness, less waste, less plant cost, a reduction of labor, etc., are all factors of money value which may often more than balance the greater cost of the heat.

The temperature of the arc, being that of the volatilization of the electrode material, will volatilize anything that can be used as electrodes. At the very high temperature of the usual carbon arc probably all chemical compounds are disassociated, that is, chemical affinity then ceases to exist. This makes chemical separations and recombinations possible that are not possible in fuel furnaces.

The fixation of nitrogen electrically for fertilizers is already a thriving industry, but the efficiency is so extremely low, said to be only a few per cent, that there are possibilities of enormous improvements in output per horse-power.

In general, many chemical operations may be brought about better by electrochemical means, and further developments in this direction are very probable.

By far the greatest gold mine in the world is the water of the ocean, which will always be free to everyone. If ever it should become possible to extract any of this immense quantity of gold, it will no doubt be by electrical means.

The fact that lightning often accompanies the formation of rain from suspended moisture shows us that there is some connection between them, though the electric discharges may in this case be a consequence and not a cause of the condensation. It is known, however, that finely suspended matter can readily be condensed by electrical means, as is now done commercially with the dust in flue gases, hence the possibility of electrically dissipating fogs and the electrical production of rain (when the water exists in the atmosphere) may be among the possibilities of the future.

The treatment of diseases by heat or by some of the little known new forms of rays, or by still undiscovered rays, may be one of the important developments of the future, in which case electrical energy will no doubt be used as the most easily available medium.

Wireless telephony is already an accomplished fact, and over remarkably long distances. Its development will no doubt be great for cases where wire telephony is impossible or impracticable. It has been prophesied that electric power in large amounts will in the future be similarly distributed wirelessly. But the fact that the power from the source radiates in all directions, leads one to believe that such distribution of power would at best be limited to cases in which the very low efficiency would be overbalanced by other advantages, as for instance in the propelling of torpedoes. A means of condensing and directing such electromagnetic waves, as the megaphone does with sound, would, of course, be of immense value in all wireless transmissions.

Extremely high frequencies in the alternations of

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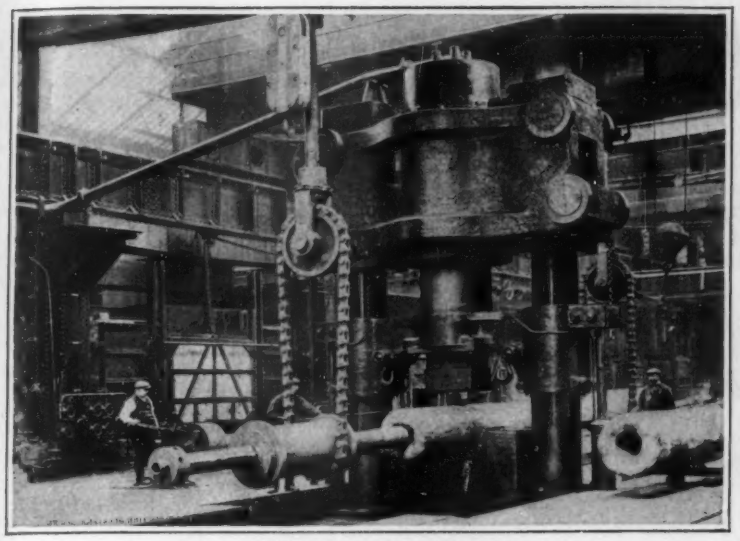


Fig. 1.—Hydraulic press forging the inner tube

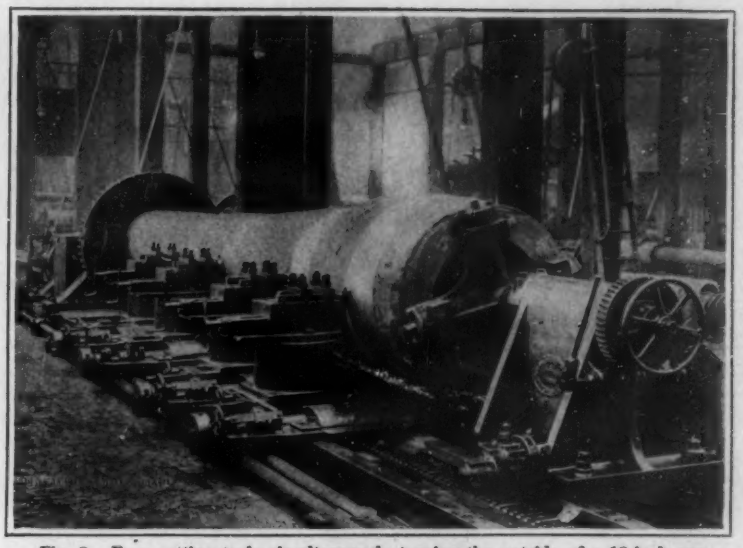


Fig. 2.—Four cutting tools simultaneously turning the outside of a 12-inch gun

The Manufacture of English 12-Inch Guns

By Carl F. Jeansen, Ordnance Engineer, Washington Navy Yard

THE material used in the manufacture of English naval guns is open-hearth steel which is cast in vertical ingots, the cross-sections of which are from two to six times the area of the cross-sections of the final forgings. Top and bottom of the ingots are cut off to remove impurities and blowholes. The ingot is heated, pierced and forged out on mandrels to the required length by immense hammers. Fig. 1 shows a tube forging in the process of being forged out. The forging is then rough turned, annealed and oil tempered.

All the processes of manufacturing the forgings are closely inspected and test specimens are cut from the forgings and pulled apart in testing machines. Records are kept of the elastic limit, tensile strength, elongation and contraction of area, etc. If the test specimens do not come up to specifications the forging is rejected. Chemical and microscopic examinations of the steel are also made.

The guns are built-up, wire-wound guns. The central part is the inner tube or liner on which the outer tube is shrunk. Square section wire is wound under tension on the outer tube, compressing the same. Over the wire the jacket and the chase hoops are shrunk.

In shrinking on the parts, the outer part is first bored to prescribed size and then the inner part is turned to a size slightly larger than the bore in which it is going to fit. The difference in diameters or the shrinkage is computed and a variation of one one-thousandth of an inch (plus or minus 0".001) is allowed in turning the surfaces. Extremely heavy and accurate lathes and the highest workmanship are required for this work. A gun lathe is shown in Fig. 2 turning the outside of a 12-inch gun. On this particular lathe, four cutting tools are used.

For shrinking on a hoop, it is heated in specially constructed heating furnaces. As the heat expands the metal the bore also enlarges and will finally be larger than the part of the gun over which the hoop is going to fit. The hoop is then taken out of the furnace and lowered down over the gun, which has been put in a vertical position in the shrinking pit. It is then allowed to cool, water being used to hasten the cooling.

The shrinking on of the different parts and the winding on of the wire under tension compresses the bore of the gun. In firing the gun the powder pressure has to overcome this compressive stress before the surface of the bore is subjected to tension.

When the gun has been built up, the powder chamber and the bore are finish bored. The gun is now ready to be rifled. Fig. 3 shows the muzzle end of a 12-inch gun and the rifling head with its cutters. The rifling head shown cuts simultaneously four rifling grooves, the cutters being placed 90 deg. apart. At the front end of the rifling head a steel brush is attached for cleaning out the chips. The rifling head is attached to a long bar in which a spiral groove is cut. In a bearing for the bar a hole is drilled. A pin is inserted through this hole and projects in the groove. When the bar is pushed forward, the pin forces the bar to rotate and the cutters thus reproduce the spiral groove in the bore of the gun.

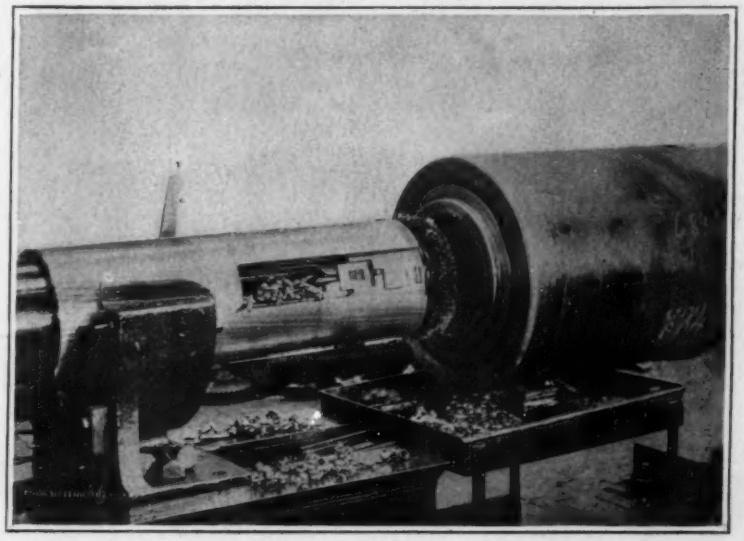


Fig. 3.—Rifling head cutting grooves in a 12-inch English gun

The breech recess in rear of the chamber is now threaded for the breech block and the breech mechanism fitted to the gun. A completed 12-inch gun with breech mechanism assembled is shown in Fig. 4.

The gun is next proof fired as shown in Fig. 5, and is now ready to be issued to the service.

Each time the gun is fired a slight erosion of the bore takes place. Gradually the rifling in the bore wears away. When a 12-inch gun has been fired 100 to 225 shots it does not shoot accurately and has to be replaced. The worn gun is, however, quickly put in service condition. The breech mechanism is removed. The liner is threaded in the breech end and a plug screwed in. The gun is heated in a furnace and when the desired temperature is reached it is removed from the furnace and placed breech down in the shrinking pit. Water is introduced in the bore causing the liner to contract, a long iron rod is put in through the muzzle and rests on the plug in the breech end of the liner. A weight is dropped on the rod, forcing out the liner. The gun is lifted out of the pit, leaving the liner. Then a new liner is inserted in the gun.

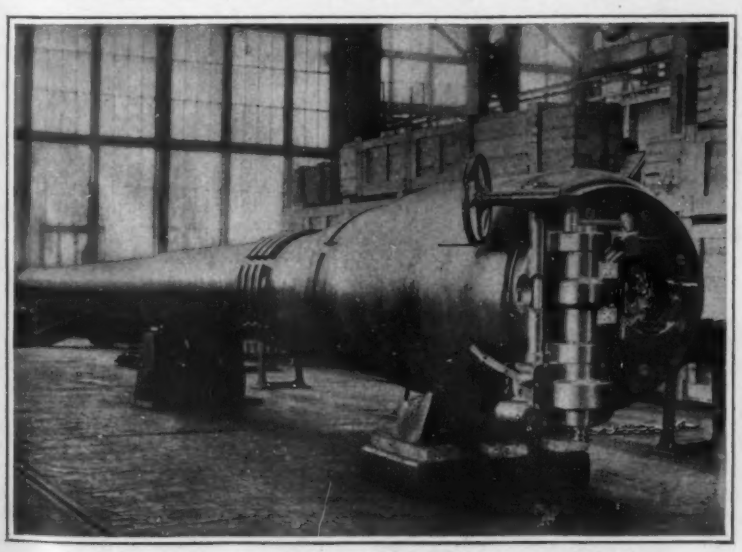


Fig. 4.—The breech mechanism of a 12-inch wire-wound English gun

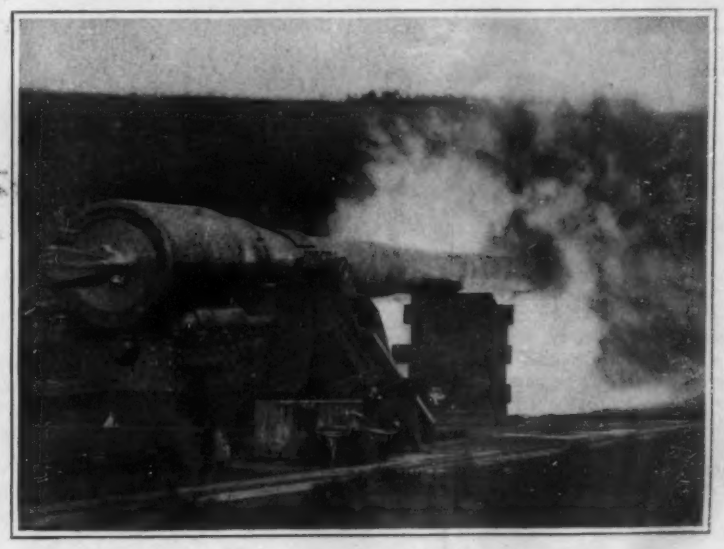


Fig. 5.—Testing a completed English naval gun

The Intermittent Waterfall

Using the Power of Niagara Falls Without Impairing Its Scenic Beauty

By E. Dunn

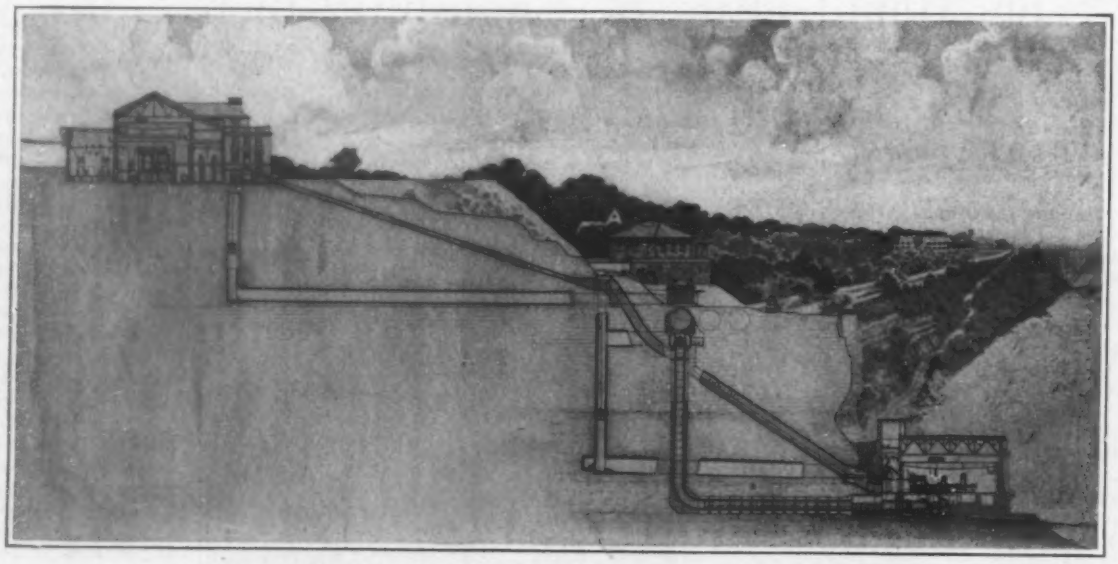
[The author of the project, here outlined, for the hydroelectric utilization of our great cataracts without material impairment of their scenic beauty, is Prof. Thomas H. Norton, of the Bureau of Foreign and Domestic Commerce. He is well known to the readers of the Scientific American *through his recent contributions on the Dyestuff Famine. His extensive report on "The Utilization of Atmospheric Nitrogen," published by the Department of Commerce in 1912, is regarded by electrochemists, on both sides of the Atlantic, as the most complete and exhaustive treatise on the subject in any language. The accompanying article is from the pen of one closely associated with Prof. Norton in the study of hydroelectric problems.*—Ed.]

THE question of the complete utilization of the world's waterfalls as sources of motive power, of illumination, and especially of the essential factor in our swiftly expanding electrochemical industries is becoming more and more a matter of vital importance in the economic evolution of a number of countries. This is notably the case in our own land. It is destined soon to become a burning issue in Labrador, in South Africa, and in Argentina, to cite simply the most striking instances outside of our borders.

In Europe, one after another, nearly all the waterfalls, once serving as shrines for the lovers of scenic beauty, have been harnessed, and reduced to a sullen and prosaic serfdom.

In North America the best known of the world's great cataracts, Niagara, is located. There is also a multitude of waterfalls of relatively lesser importance, but each one representing a potential force of considerable magnitude

Many of these waterfalls constitute the central feature in landscapes of rare beauty and singular impressiveness. They attract large numbers of the genus *tourist;* some genuine worshippers of Nature in her most majestic moods; the greater number falling into the species of merry picnickers.



Sectional view taken through one of the proposed power plants

Bird's-eye view of Niagara showing the main dam and the diversion dam at the head of Goat Island

Utilitarianism versus Estheticism

Party lines have been drawn and the issue has been sharply defined between two active and opposing factions. One category, small in numbers, but resolute in conviction, demands most emphatically that the scenic glories of the nation's watercourses shall never be impaired; that every citizen possesses an inborn right to enjoy to the full the inspiration and the charm of a Minnehaha or a Niagara, untouched by the vandal hand of commercialism.

The other class insists that it is an economic wrong to the nation at large to allow vast stores of energy to go to waste. Its adherents show how thoroughly the waterfalls of Europe have been brought into the service of civilization, and demonstrate the nonwisdom, in a competitive age, of squandering enormous assets of power, which might contribute to a marvelous extent in assuring the comfort and well-being of untold thousands.

In the case of Niagara a temporary compromise has been reached by the international treaty of 1910, permitting the diversion of nearly one quarter of the mean flow of water. This amounts to 56,000 cubic feet per second, of which 20,000 second-feet can be diverted on the American side of the falls, and the remainder on the Canadian side. This compromise has not been satisfactory to either party. Some appeal for a restoration of the volume of water to the normal quantity, which, as geologists declare, has poured continuously over the brink of Niagara for nearly forty thousand years. Others, aiming at a rapid economic evolution of Western New York and Ontario, claim vigorously that the time will soon be ripe for the utilization of *all* the potential power of the mighty cataract.

A Compromise

It has remained for Prof. Thomas H. Norton, of the Department of Commerce, to propose a solution of this complicated problem, which has attracted wide attention throughout both the United States and Canada.

Like many other solutions of mechanical difficulties, the project is of the greatest simplicity. Its essential feature is the *intermittent waterfall.* During somewhat more than half of the twenty-four hours, especially during the night-time, a waterfall is completely harnessed. Every kilowatt which it is capable of creating is devoted to the service of industry. During a shorter period—from 10 A.M. to 8 P.M.—the waterfall resumes its normal activity, contributing to the esthetic enjoyment of all who behold it as it obeys the behests of gravitation and offers the same picture of beauty displayed through eons, with but the almost negligible changes due to slow erosion.

Evolution of the Project

Prof. Norton relates that the project first occurred to him in a vague way as he floated, a few years ago, down the river Euphrates on one of those picturesque rafts of inflated goatskins used for thousands of years in Western Asia. As the bubble-like craft danced and whirled for over twelve hours on the tossing waves, while speeding swiftly downwards through the grand canyon of the Taurus Mountains, through rapids, cascades and whirlpools, he could not but mourn over the immense wastage of potential power each minute and second, which, when duly harnessed, might turn that wild, barren region on either side into a garden of beauty and a center of industry.

Later he stood in a Norwegian valley—a gash in a lofty mountain chain. Not long before there were a few, scattered peasants' cottages in this valley. A waterfall of exquisite beauty leaped over a towering cliff. Now the veil of water has vanished. In its place prosaic penstocks, side by side, extend down the rocky slope. At the base the solid construction of an electric power-house. A maze of cables connect with a gigantic structure flanked by towers of granite. In this building, equipped with enormous electric furnaces, marvelous transformations take place. The invisible air which we breathe is forced in by mighty fans. Aided by the power gained from the vanished waterfall, and with the friendly cooperation of a tumbling mountain stream, the air is transformed into one of our most important chemicals—nitric acid, the chief factor during these tragic days in deciding the fate of nations!

The central feature of this picturesque vale had disappeared. It was replaced by a chemical epic—the transmutation, in the fierce heat of an electric arc, of the elastic medium in which we live into a most powerful and corrosive liquid! As a corollary, a newly-built town of several thousand inhabitants was crowded between the cliffs, lower down the valley, and the busy hum of industry had invaded the peaceful quiet of the mountains. It meant also much of comfort and happiness to hundreds of thrifty Norwegian families formerly gaining a scanty living

amidst the rocks and boulders of an inhospitable region.

The problem of the Niagara gorge naturally came to mind. Was there any compromise to be reached between the utilitarian and the esthetic—any practical, workable thesis according to the terms of which the rights of the inhabitants of this continent would suffer no material diminution in the opportunity to enjoy Niagara in its full splendor while permitting the utilization on an extensive scale of the tremendous source of power, one of the nation's grandest assets?

Application of the Principle to Niagara

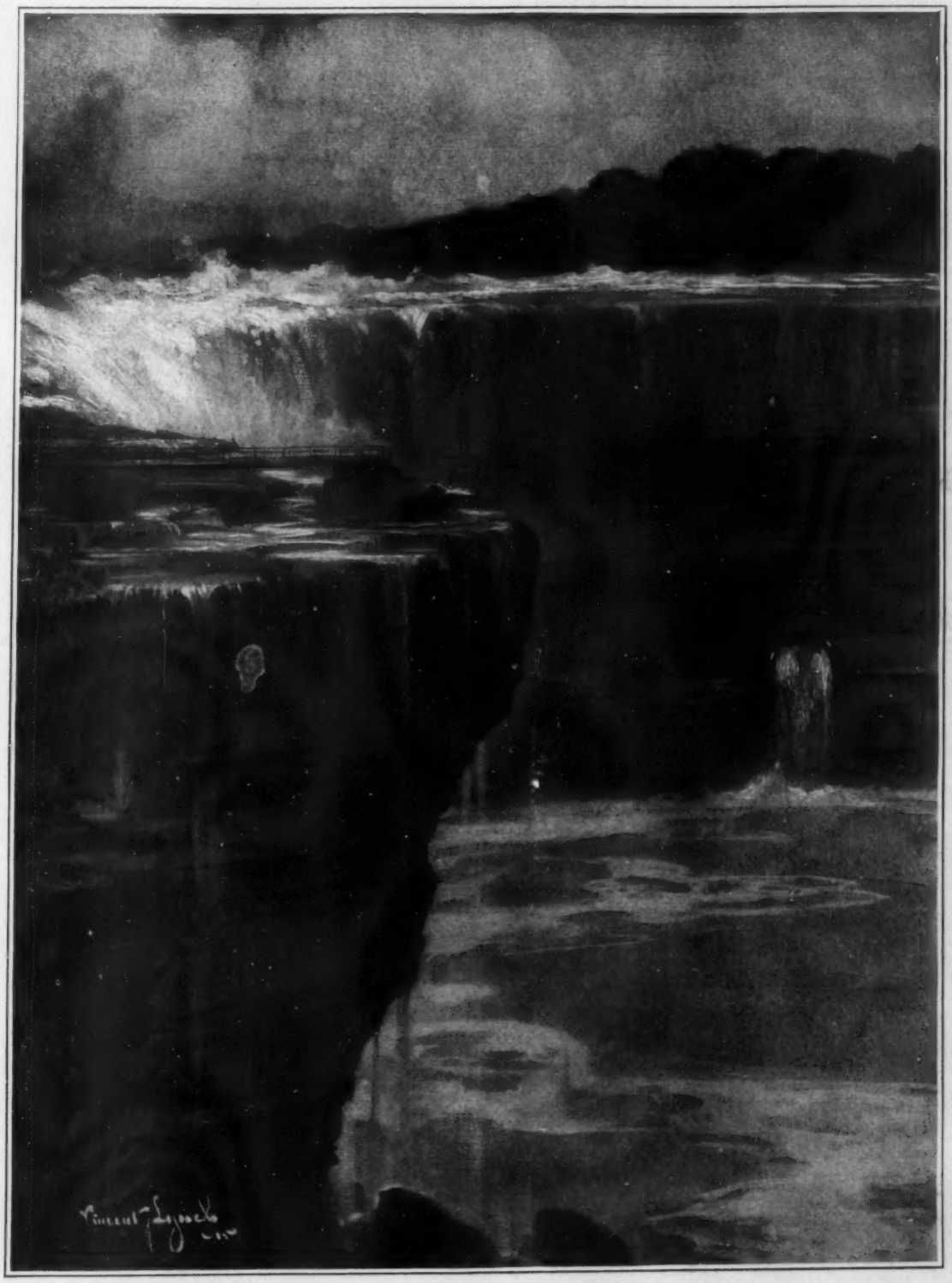
The principle of the intermittent waterfall is susceptible of application to any cataract or cascade, or any series of rapids located within a gorge of relatively short length.

It is most easily illustrated by describing the manner in which the enormous power of Niagara Falls and the Niagara Gorge can be effectively utilized for hydroelectric purposes without seriously affecting its value as the continent's chief scenic jewel.

The waters of the series of Great Lakes find their outlet at the eastern end of Lake Erie, whence they descend to the level of Lake Ontario by the Niagara River. The mean volume of flow is 220,428 feet per second. It varies from 187,256 to 238,599 second-feet.

The course of Niagara River in flowing from one lake to another presents three pronounced variations of level. The most notable is that of the famous cataract, 167 feet in height. In the rapids immediately above the falls there is a descent of 46 feet. Another descent of 102 feet gives rise to the so-called Whirlpool Rapids, occupying much of the gorge, extending from Niagara Falls for about 7 miles northward to the town of Queenstown, where the Niagara escarpment terminates. The total fall from the head of the upper rapids to Queenstown is 315 feet. There is also a fall of 14 feet from Lake Erie to the head of the rapids.

It is the descent of 315 feet occurring within a few miles which interests the hydraulic engineer.



Rebirth of Niagara Falls an instant after the opening of the gates in the dam

The Hydroelectric Harnessing of Niagara

One quarter of a mile above the western extremity of Goat Island, where ripples betray the beginning of the upper rapids, a dam would be constructed at right angles to the axis of the river. The length would be about four fifths of a mile. Niagara River at this point is exceedingly shallow. Equidistant soundings from the American shore to the Canadian shore show successive depths of 1, 2½, 1½, 2½, 3½, 7½, 7½ and 4 feet. The average depth is 3¾ feet. It is evident that the construction based upon the rocky bed of the river would be relatively easy and inexpensive.

Such a dam would be fully equipped with the necessary gates, arranged for rapid and simultaneous opening and closing. The water impounded by the closing of the gates could be conducted by huge canals on both sides of the gorge to the edge of the bluff overlooking Lake Ontario. From this point a multitude of penstocks and rock tunnels would conduct the entire volume of water to the level of the river near Queenstown on the Canadian side and Lewiston on the American side, where battalions of power-houses can easily be located.

The total section of the system of canals and penstocks required for the complete utilization of the average flow of Niagara River would be approximately 16,000 square feet. The mean flow of water, with a hydrostatic head of nearly 315 feet, would produce about 7,400,000 horse-power.

Such would be the hydroelectric installation required to harness Niagara completely. The cost would certainly be notably less than the $500,000,000 expended on the Assouan dam of the river Nile.

And now, once provided with the mechanical means to control the vast volume of water ordinarily sweeping over the crest of Niagara, the daily programme cannot better be described than in Prof. Norton's own vivid diction:

Niagara Enslaved—Niagara Freed

"At 8 P.M. the entire series of gates on the dam would simultaneously close. A few minutes later and the American Falls would falter. The volume of water would swiftly diminish. Soon the grand curtain would be rent and gashed as if by invisible knives. A minute or two more and rivulets here and there pour over the brink. The gloomy, cavernous recesses beneath the overhanging edge are revealed to the eye. Another minute, and the rivulets have changed to drops.

"From Goat Island to the apex of the great Horseshoe the same sequence of transformations begins. It creeps steadily along the crest until it reaches the Canadian shore. The deafening roar of the cataract sinks to an agonizing groan, a reproachful sigh, a dying murmur. Niagara is silent!

"A few minutes later and the rage and fury of the long stretch of rapids in the picturesque gorge falter and slowly subside. The vast volume of water between the foot of the falls and Queenston gradually drains away. A quiet lake remains between the railroad bridges and the base of the falls. Its surface is about 86 feet below the normal level, and the enclosing cliffs gain that much in height. It would be somewhat narrower than the present river, and frequent rocky islands would appear near the temporary banks.

"For three quarters of a mile the relatively narrow and shallow bed of the whirlpool rapids would be laid bare. The whirlpool itself would remain a somewhat restricted and motionless sheet of water, 40 feet below its normal level, at the head of a quiet fjord extending inland from Lake Ontario.

"Such would be the topographic changes attending the harnessing of the cataract.

"Synchronously with the vanishing of the falling tons of water, in thousands of workshops scattered over the fruitful territory of Ontario and New York a million, perhaps many million, workmen begin their daily task. For 14 hours the world's greatest beehive of industry is filled with the busy hum of activity, keyed to the highest pitch, banqueting, as it were, on the corpse of a murdered Niagara! One shift of seven hours is succeeded by another of the same length; and all the energy of the 7,400,000 horse-power is devoted to the welfare of the nation.

"It is 10 A.M. As the signal is flashed from the National Observatory the gates of the great dam shoot upward. The hum of the spindle and loom, the clang of the triphammer, all the many-toned gamut of sound which forms the orchestral accompaniment of a busy, happy people shaping, fashioning, creating the objects

(Concluded on page 505)

Electricity in Present-Day Warfare

Serving Two Diametrically Opposed Functions: More Efficient Warfare and Better Treatment of the Wounded

A GENERAL review of the more important applications of electricity to warfare is indeed a revelation. Warfare without electricity would not be modern warfare, so indispensable is the electric current in the functioning of an army of the present time. The range of application of electricity is as vast as it is diversified: powerful currents are used to kill men—weak currents are used to detect bullets imbedded in the flesh of the wounded; big searchlights turn darkness into artificial daylight—small pocket flashlamps furnish illumination to the men in the trenches; and so on down through the divers uses of electricity by the fighting forces of Europe. One instant electricity is serving to make warfare more efficient—more deadly and terrible; the next moment it is serving a humanitarian mission in a hospital in back of the lines, ameliorating the sufferings of the wounded. This war has been aptly called a war of machinery. But is it not equally logical to name it the war of electricity?

Portable Electric Plants and Flashlamps

Electric lighting is as popular with the armies in the field as it is with the people in the towns and villages far removed from the battle front. Indeed, one of the first moves following the occupation of an enemy village or city is the locating of the electric plant of the community by the engineering corps, followed by such repairs as may be necessary and the starting up of the generators, so as to furnish illumination to the buildings and thoroughfares.

But an enemy is not always so courteous as to leave the power plant in perfect order. More often the machinery is damaged beyond repair, necessitating the use of new equipment. The Germans in invading Belgium and the northern districts of France anticipated just such emergencies and, with their characteristic thoroughness, provided their armies with transportable electric plants, consisting of an oil engine, a generator, switchboard, tanks and other accessories mounted on a substantial truck. Where damaged power plants were encountered, it was but the work of a few minutes to connect the portable equipment with the supply wires of the community. Although the portable electric lighting plants of the Germans do not exceed a few kilowatts in capacity, they are sufficient for the needs of small communities and for the illumination of military quarters.

Pocket flashlamps are used to some extent by the fighting men, as evinced by the fact that firms in England, France and Germany have, since the beginning of the war, developed certain types of flashlamps especially suited to military service. The majority of these are flat, with the lamp contained in a suitable reflector and mounted on one of the sides, and are provided with a hook permitting of their being hung from a button on the uniform of the user. Flashlamps are popular with the men in the trenches, since they furnish sufficient illumination for reading newspapers and periodicals, yet their rays are carefully shielded and hence do not invite a volley of bullets or hand grenades from the nearby enemy trench.

Other uses have been found for electric flashlamps aside from that in the trenches. Lieut. D'Oyley Hughes, a member of the crew of a British submarine operating in the Sea of Marmora, included a flashlamp in his equipment when he undertook a daring raid on a viaduct of the Ismid railway. Stripped to the skin, he pushed a raft before him through the water, bearing the explosive charge for blowing up the Turkish viaduct, his clothes, a sharp bayonet, a revolver and a so-called electric torch. Obviously, no other form of illuminant would have been as efficient for his purpose, and it is more than likely that flashlamps are being widely employed by others engaged in similar military missions.

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Behind the lines in Russian Poland—A German "telephone general" and his staff

Night and Day Use of Searchlights

Night fighting has been developed to the greatest extent during the present war. Prior to the Boer war it was the practice of contending forces to fight during daylight and seek rest at night, but the remarkable development of appliances for illuminating entire battlefields, rendering them as bright as daylight, has resulted in the introduction of nocturnal engagements on an unprecedented scale.

Every army engaged in the titanic struggle in Europe, from the smallest to the largest, is plentifully supplied with mobile searchlight equipments that can be posted at any spot. In the majority of instances the searchlight equipments consist of an automobile truck carrying a generator that is driven from the vehicle's engine, and the searchlight mounted on a small four-wheeled carriage, permitting of its removal from the automobile truck and of wheeling it to a spot several hundred feet away that may be inaccessible to the larger vehicle. In the more improved forms of transportable searchlights, the projectors are fitted with a remote control system so that the attendant, standing perhaps twenty or more feet distant, can, by means of a small control board held in the hands, direct and alter the beams. Thus he is not blinded by the terrific glare of the rays, which would be the case were he standing close to the projector. Many of the portable projectors have a range of 5 miles or more.

Electric searchlights are also employed in daytime for signaling purposes, for which use they are provided with a number of hinged metal shutters that may be rapidly opened or closed as one by a lever or key at the side of the lamp. A proficient telegraph operator can transmit dispatches at a slow speed by this means, and owing to the intense brilliancy of the projector, a range of several miles can be thus covered.

Electricity an Ever-Watchful Sentinel

The deadliness of high voltages has not been overlooked by the military scientists. In the present war electrified fences have not been used to any great extent at the front. It is rather in the rear of the lines that electricity has been enlisted as an ever-watchful sentinel in mounting guard over the numerous captives placed in prison camps, as well as in preventing the escape of Belgian refugees to neutral Holland. Most effective are barbed wire inclosures charged with electricity, since they minimize the number of guards necessary yet insure the instant death of any prisoner who may attempt escape. In order that accidental contact may not occur, the electrified fences are usually sandwiched between ordinary barbed wire fences. Perhaps the most elaborate form of electrified barrier is that erected by the Germans along the Belgian-Dutch frontier for preventing the escape of the conquered Belgians. The barrier consists of three barbed wire fences, the two outer ones without current and the center one carrying a high voltage charge. Guards patrolling the barrier are provided with special hooks that have insulated handles, with which bodies of victims may be removed without danger to the user and without the necessity of turning off the current.

The extent to which electric motor drive has been enlisted in military activities is difficult to estimate, although the development of utmost efficiency in all the countries engaged in war should tend towards the increased employment of electric motors. On the other hand, it is known that electric automobiles and heavy trucks have not been used to any appreciable extent by the the fighting forces, but this is probably due to the difficulty of providing charging stations for the accumulators.

The deadly gases used by the Germans are but another indirect application of the electric current. Chlorine for military purposes is a by-product in the manufacture of hydrogen for airships by an electrochemical process.

Electrical Ears Locate the Invisible

Most striking is the employment of electricity for locating invisible enemies. Erstwhile invisible aircraft,

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Italian transportable wireless station of one and one half kilowatt capacity

German searchlight of a most modern type, mounted on telescopic supports

Serbian searchlight fitted with a shutter and used for daylight signaling

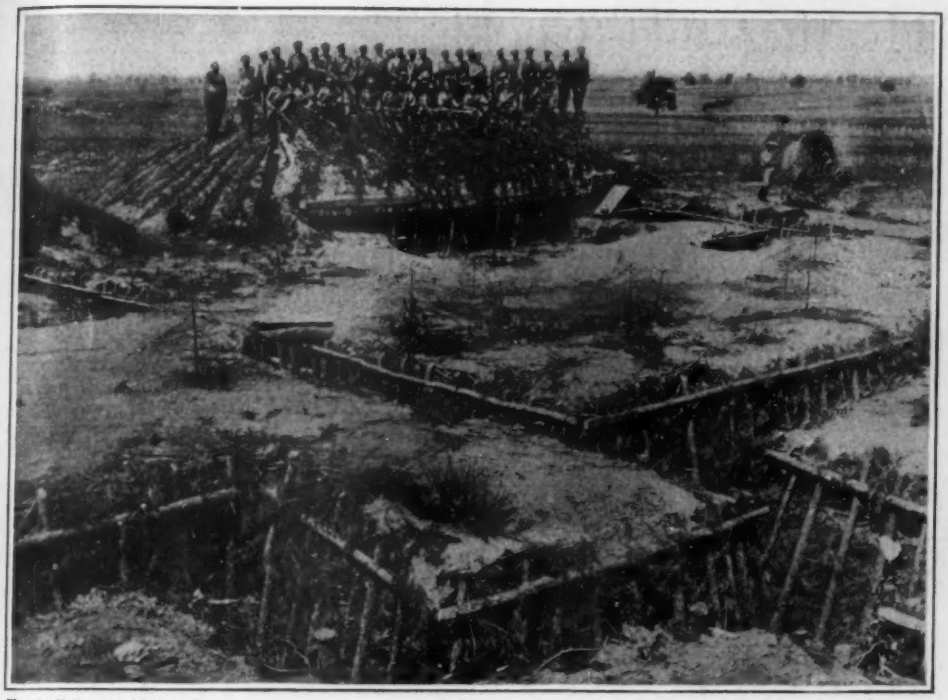


Photo by Underwood and Underwood

Dugouts and trenches somewhere in Poland, forming Russia's present first line of defense

Fenture Photo Service

A French rapid-fire airship gun captured by the Germans

German soldiers making portable barbed wire obstructions behind the lines

Fenture Photo Service

German soldiers being drilled in the setting up of barbed wire fences

Mc/bun Photo Service

An Australian battery in action at Gallipoli. The gun is shown an instant after discharge, with the recoil cylinders drawn out to maximum extent

PICTURES FROM THE WAR FRONT

Electric Heating and Cooking

Some Suggestions as to Possible Future Development

By P. Wilcox Gumaer

DURING the past century there has been a great advance in the methods of applying heat to food. Each improvement has resulted in less waste of the heat energy and in a greater absorption of it by the food. Each step from the open fireplace to the coal range, to the gas stove, and finally to the electric range has been marked by the use of more expensive fuel, greater heat efficiency, better control of the heat and more satisfactory food.

Electric cooking at the present time has reached a state of development similar to that of the electric light about 1890. While still a luxury in some communities, it is being rapidly introduced at rates which allow direct competition with gas. At three cents per kilowatt hour the housewife who owns a modern electric range can cook as economically as a person who uses a gas range and pays a dollar per 1,000 cubic feet for the gas.

From the crude, unreliable, and inefficient electric cooking apparatus first offered to the public, there have been developed the attractive, economical and durable devices of to-day. Many difficult problems of design have been solved, the greatest of which has been the electrical insulation at the high temperatures. Mica, the best insulator available at the highest temperatures met with in the other electrical apparatus, becomes a source of frequent breakdowns when used at the extreme temperatures necessary in heating devices. The dehydration temperature of the mica, 800 deg. C., is the limiting factor to the operating temperature of the unit when that insulation is used. The rate of flow of the heat into the cooking utensil from the material in which it is generated by the electric current is proportional to the temperature of that material. Hence, apparatus in which mica is used adjacent to the heating material must be very slow in operation when compared with gas or coal.

Porcelain has been used by some manufacturers as an insulator and support for the heating unit. Coils of michrome wire are stretched in the grooves of a porcelain support. This heating unit has been popular with persons accustomed to the use of a gas flame, as the coils of wire become red hot and give the appearance of intense heat. In order to insulate the live coils from the cooking utensil about an eighth of an inch of clearance is left between the coils and the top of the porcelain support upon which the utensil rests. Since air is a poor thermal conductor the heat is transmitted to the cooking utensil by radiation and convection rather than by conduction. For heating large quantities of water or food and for continuous operation, these units are not as efficient as other types. For heating small quantities, however, they are more rapid in operation, due to the small mass and low thermal capacity of the unit.

Recently an entirely new heating unit has been developed for electric heating devices. The high resistance wire through which the electric current flows is enclosed in a steel sheath, and insulated therefrom by a material which will withstand excessively high temperatures without deterioration. The core wire and the powdered insulation are inserted in the sheath when the three are large in diameter. They are then rolled and swaged to the proper size. By an ingenious arrangment, the ends or terminals of the unit are left large in diameter, as shown in Fig. 1. This facilitates the attachment of terminal connections and permits the terminal to operate at a low temperature.

The outside metal sheath protects the core wire from oxidation when operated at high temperatures, as air cannot penetrate through the sheath and as the core wire is large in cross-section and comparatively cool where it is exposed to the air. If the operating temperature of the sheath is to exceed 400 deg. C., the unit is calorized. This protects the steel from oxidation so that it may be operated at very high temperatures for several thousand hours.

This type of heating unit lends itself readily to the construction of a hotplate or stove, which is practically ideal. The sheathed wire is arranged in a flat coil and molten iron is cast around it. The result is a heating unit, which is as rugged and durable as an old-fashioned stove lid. Fig. 2 shows a cast iron hotplate without its thermal insulation underneath. Good thermal contact is obtained from the resistance wire to the sheath, to the cast iron and by means of the smooth flat surface to the dish of food. This low thermal resistance path for the heat and the heat insulating pad beneath the unit secure an especially high efficiency. The smooth top and flat surface of the heating unit are ideal for cleanliness as there are no grooves or crevices in which dirt or spilled food can collect. Oven and broiler units are constructed as shown in Fig. 3. As the sheath does not have to be insulated from the oven the most simple of metal frames suffices for the support of the heating unit.

On the Pacific coast where cheap water power is available and where coal is expensive, electric heating of the dwellings and offices is economically practical. Rates as low as half a cent per kilowatt-hour have been offered by power companies for continuous loads, such as water heating and house heating. An interconnected water heater and electric range have become very popular in that section. The range and the water heater are connected to the same switch so that when the

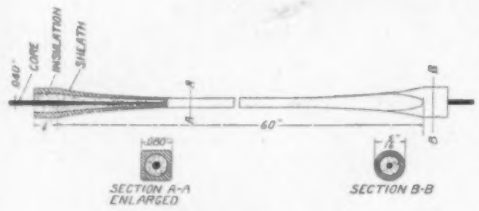


Fig. 1.—Sheathed wire

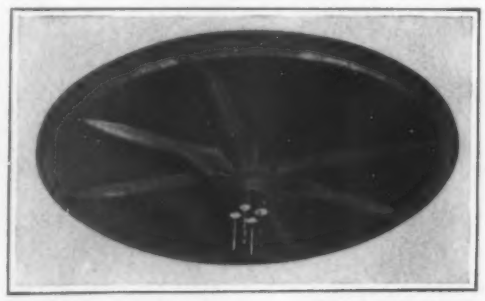


Fig. 2.—Sheathed-wire hot plate

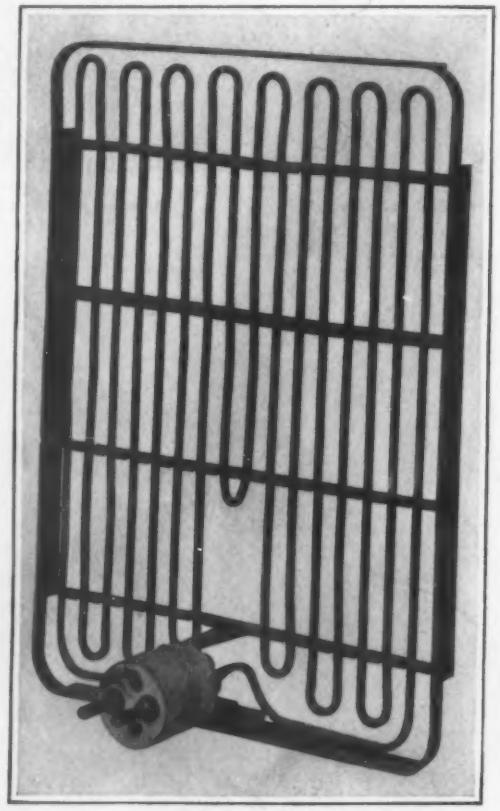


Fig. 3.—Open-coil sheathed-wire heating unit

range is not in use the power is used to heat water for household purposes. This arrangement results in a very high load factor.

The heating of residences by electricity in the east where cheap coal is available is very far in the future. In a pound of coal there are approximately thirteen to fourteen thousand British thermal units and in a kilowatt-hour 3,415 British thermal units. Hence, a pound of coal contains as much energy as four kilowatt-hours. Assuming an efficiency of 25 per cent for a coal furnace and 100 per cent for an electrical radiator, a pound of coal will furnish as much heat as one kilowatt-hour. Neglecting cost of attendance and maintenance, direct competition of electricity with coal for residence heating will require a rate per kilowatt-hour equal approximately to the cost of a pound of coal.

Water heating in quantities large enough to utilize a separate coal or gas water heater is in the same class with house heating when compared with electricity. For direct competition similar low rates would have to obtain for the electrical energy except where attendance is a large factor.

The reader will probably raise the question as to why electricity is able to compete with gas or coal for cooking purposes when the cost for a given amount of energy at the meter or in the coal bin is so much greater for the electrical method. The answer is that cooking food is not a question alone of heat units. The steam boiler methods of obtaining efficiency do not give a correct indication of the cost of cooking operations.

Briefly stated, the objects of cooking food are: (1) to render it more digestible so that the digestive organs can more easily digest and absorb the nutrient parts; (2) to make the food more appetizing by improving its appearance and by developing in it new flavors; (3) to sterilize it so that it will keep longer. The relative importance of each purpose depends upon the article of food which is to be cooked. For example, in the cooking of animal foods, the improvement of the flavor and the appearance is the most important. The cooking of these foods which are rich in protein actually decreases their digestibility. This is true at least of the chemical processes of digestion, but the increased attractiveness of well cooked meat may render it indirectly more digestible by causing a great flow of the digestive juices. The effect of heat on the protein of foods is to coagulate it. This change occurs at the comparatively low temperature of 75 deg. Cent. If the temperature is increased much above this point, the protein tends to shrink and harden, and the digestibility of the food is greatly lessened thereby.

It is not desirable, necessarily, as in heating water, to put as many as possible of the heat units of the fuel into the food. In fact, the method of cooking in which the greatest number of the heat units of the fuel are absorbed by the food does not always give the most satisfactorily cooked food.

The present status of the science of cookery is due, in a large degree, to the lack of adequate means of controlling the temperature of the food. When using the ordinary wood or coal cooking range the degree of heat is controlled chiefly by dealing with the food itself rather than by regulating the heat at the point of combustion. The amount of draft necessary to promote the combustion of the fuel causes too great a degree of heat in the oven or on the stove to enable the cook to deal with the food in the proper way except by constantly watching it, stirring it, and changing the position of the vessel on the stove or in the oven. With the advent of electric ovens a revolution in the methods of cooking has become possible. Automatic electric ovens will probably be developed in which the temperature will be accurately controlled and the necessity of constant vigilance will be removed. Some kinds of food will even be prepared in advance, placed in the oven, and without any further attention on the part of the housewife the current will automatically be turned on at a predetermined time. The temperature of the oven will increase to the desired value and there remain constant until the food is properly cooked.

With this method perfected the advantages of electric cooking over the other methods will be great and in many cases the cost will not be excessive. To the possibility of obtaining uniformly well cooked food should be added the saving to the housewife in time and worry, and the absence from the kitchen of excessive heat. The present-day problem in electric cooking is to determine the methods of cooking that will yield the most in nutrition and flavor, and to formulate definite rules or directions so that a particular article of food can be cooked in the best possible manner by persons of ordinary skill. The engineer's problem is then to design practical cooking devices in which the temperature can be accurately regulated with a minimum of attention on the part of the housewife.

The increased popularity of the fireless cooker indicates that people are learning that food can be cooked at temperatures lower than the boiling point of water. The particular temperature of 100 deg. Cent. has long been the one used for cooking cereals, vegetables and meats, because it is the easiest temperature to maintain at a constant value and not necessarily because it gives the best possible results. The fact that several hours are required for the cooking is not a disadvantage when

(*Concluded on page 508*)

The wonderful lighting effects produced under the direction of Mr. W. D. A. Ryan, the General Electric Company's Illuminating Engineer, were a principal feature of the Exposition.

Electricity was used for construction, operation and lighting at the World's Greatest Exposition. The Company's products assisted in every phase of this achievement.

Recognition

From the beginning, the General Electric Company has been noted for its broad-gauge policy with regard to the progress of the electrical industry.

To this end, the largest and best-equipped laboratories of their kind are maintained for scientific research in electrical and allied lines.

In the award of highest honors for a wide range of scientific discoveries and manufacturing achievements, therefore, the Company's supreme efforts and broad purpose are fully recognized.

Research. Extensive investigations of the action of gases have been accorded the highest honors at the command of the International Jury of Awards. The Grand Prize in this case covers Vacuum and Gas Filled Lamps, Electric Vacuum furnace and apparatus for production and purification of Argon and Nitrogen.

Highest honors in X-Ray work are represented by the Medal of Honor for the Coolidge X-Ray Tube and a Gold Medal for X-Ray photography. Fibrox insulating material, Binel metal, ductile tungsten in various forms, metallic boron, boronized copper castings and calorized steel are among the other G-E Laboratory achievements to receive special recognition from the Jury of Awards.

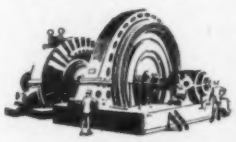
For the Home. The perfection of methods of obtaining heat from electricity will result in a wider adoption of electric power for heating and cooking in the home. The highest honors for this class of service are represented in the Medal of Honor for G-E Electro Thermal apparatus.

In addition, the G-E Electric Cooking Ranges and Flatirons were awarded Gold Medals for their specific excellence.

Lighting. MAZDA Lamps are the result not only of brilliant scientific investigation but of advanced manufacturing art as well. That the amount and quality of illumination have been greatly increased for the same cost to the consumer is another result of the broadly progressive idea which is the master purpose of every branch of this Company's activities.

The Company's achievements in this line were given highest honors in the award of the Grand Prize for Electric Incandescent Lamps and Gold Medals for Arc Lamps and Searchlights, thus completing the recognition of excellence in both interior and exterior illumination.

Electric Power. One of the first achievements of this Company was the production of the electric generator. That progress in improving this essential device has been continuous and untiring is evident in the award of the Gold Medal for Generators of both the alternating and direct current types.



In the application of electricity as power the coveted Medal of Honor was conferred on G-E Motors of both alternating and direct current types. In this is seen a recognition of a service which extends to practically every industry.

Control. The devices used on Switchboards determine the degree of control of power.

The progress made in the development of these devices and the perfection of the G-E circuit-breaker were recognized in the award of a Gold Medal for circuit-breakers and switchboard accessories.

The General Electric Company's recent contributions to the transmission phase of the industry are represented in awards for G-E Lightning Arresters. Power conversion was recognized in the awards for the new Kenetron High Voltage Rectifier and the Rectifier of the Mercury Arc Type.

Railway. Recent developments in the railway field include a ventilated type of motor, an improved platform controller and an ingenious multiple unit controller for operating cars in trains. The highest award for this important class was the Medal of Honor awarded the General Electric Company for Railway Motors and Control.

The 80-ton, 2400-volt Electric Locomotive of the type used on the Butte, Anaconda & Pacific Railway was honored by an individual Gold Medal. Larger G-E locomotives of this general type are now being placed in service on the first section of the 440 mile Chicago, Milwaukee and St. Paul Electrification, with plans for future transcontinental service in view.

Recent improvements in Headlights for railway service received recognition, and many other G-E accessories used in electric traction service are included in the lists of awards.

Marine. Already honored by its adoption in the United States Navy, the invention of a combination steam-electric equipment which propels vessels by electricity is further recognized by the Jury of Awards. A Gold Medal distinguishes this meritorious invention which prominent engineers believe to be the most revolutionary advance in marine transportation since the steam propelled vessel began its career.

The towing of ships by means of electric locomotives, as provided by this Company at the Panama Canal, the G-E Searchlight and the Battery Truck Crane were among other products to receive special awards.

Mining. That mining can now be conducted on safer and better methods by the use of electricity is due to an exhaustive study of the application of electricity to this important industry. The G-E Miner's Lamp and the safe and economic method of underground transportation by means of G-E Mine Locomotives were suitably recognized by the Jury of Awards.

Measurement. Electrical measuring instruments have reached the stage of efficiency where it is practical to indicate or record every electrical condition in a large power station or determine accurately the amount of power consumed on the smallest circuits. G-E measuring instruments were recognized as a whole, and the steam and water meters and the multi-recorder were among the specific devices to receive special awards.

Industrial. Many products which are of special value to a wide range of industries were among the awards. G-E Fabroil Gears, which have taken the noise out of machinery, the Vacuum Furnace, an electric welding outfit and the Genemotor starting and lighting equipment for automobiles were awarded special medals by the Jury of Awards.

The complete list of awards granted the General Electric Company includes two Grand Prizes, six Medals of Honor, twenty Gold Medals and eight other recognitions. It is a significant fact that the International Jury of Awards, in denoting standards of excellence for achievements such as these, selected the products distinguished by the G-E trademark.

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RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining To Apparel

COMBINED DUST CAP AND WATERPROOF HAT SHIELD.—J. T. CRAW, 33 Ege Ave., Jersey City, N. J. Among the objects of this invention is the provision of a device, which is of a light and preferably cheap material, adapted for either a dust protector for the head, as may be used when traveling, or to be applied as a shield for a hat, to protect the same from moisture or the like.

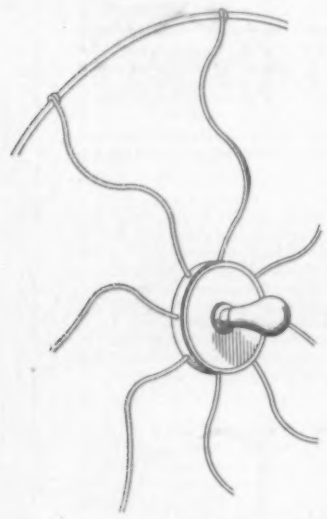
COMBINED CLAMP AND COLLAR BUTTON.—F. E. Glynn, Box 584, Grand Junction, Colo. This invention is an improvement in a type of collar buttons comprising a clamp adapted to secure the meeting ends of a shirt neckband, and having a stud attached for engaging and securing the ends of collar. It may be used in connection with various types of shirts or other garments.

CORD FASTENING SEAL.—O. D. BELL, 217 Fenimore St., Brooklyn, New York, N. Y. It frequently happens when a garment is sent out for approval to a prospective purchaser, that the latter removes the tag, wears the garment, and replaces the tag and returns the garment. The improved seal provides means whereby the tag cannot be removed from the garment without detection.

ADJUSTABLE BANDEAU.—B. WERTHEIMER. Address F. F. Eisemann, 41 Park Row, New York, N. Y. The invention provides an adjustable bandeau for ladies' hats and permits convenient adjustment as to size to properly fit the wearer's head. Use is made of an adjustable number slidable on the inner edge of the head band and having overlapping ends to permit of adjusting the number for increasing or decreasing the size of the head band to fit the wearer's head.

Electrical Devices

ELECTRIC FAN GUARD ATTACHMENT.—T. O. DARNEY, Clarksdale, Miss. The operation of shifting the direction of the air current of electric fans of the desk, or table, and other well known types, carrying guards, when the fans are in rapid motion, is often accompanied by a feeling of apprehension and by a degree



ELECTRIC FAN GUARD ATTACHMENT.

of nervousness and mental discomfort, due to the apparent danger of bringing the fingers in contact with the revolving fan blades. The invention obviates the foregoing objections by the provision of a handle whereby the operator shifts the fan without danger to him.

SIGNAL BELL.—J. CHARLAND and R. A. O'CONNOR. Address the latter, Box 363, Copper Cliff, Ontario, Can. This invention provides a bell which produces but one stroke on the gong for each actuation of the circuit closer; provides a clapper consisting of one section of a divided core within a magnetic coil, and provides a clapper which immediately recedes from the gong after each stroke, in order not to deaden the vibrations of the gong.

Of Interest to Farmers

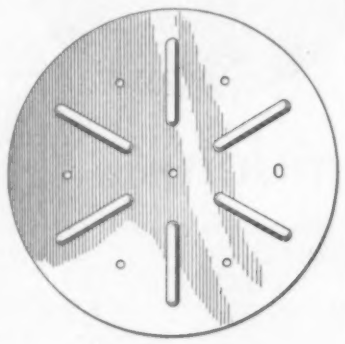
HOE.—F. ZIMA. Address W. M. Condon, Pres. Bank of Otis and Murphy, Humphrey, Neb. This invention relates to gardening implements and more particularly to an improved hoe. One of the principal objects is to provide a hoe especially adapted for the weeding and cultivation of closely planted vegetables such as sugar beets, etc.

FERTILIZER DISTRIBUTER.—A. D. COX, Box 14, Winterville, N. C. One of the principal objects of the invention is the provision of a distributer having a reciprocating bottom or floor adapted to be actuated from the ground or drive wheel of the device whereby to insure even distribution of the fertilizer.

GRAIN-SAVER ATTACHMENT FOR REAPERS.—W. SMITH. Address M. H. Scott, Attorney, Piper City, Ill. The invention pertains to grain-saving devices for reapers and harvesters, and one of the principal objects is the provision of such a device in the nature of an attachment adapted to be utilized in the place of the ordinary grain platform commonly in use.

CORN PLANTER.—W. BROWNING, 1220 W. 27th St., Oklahoma, Okla. The object in this case is to provide a planter of the check rower type, wherein the dropping mechanism is actuated from the wheels of the machine to drop a series of grains at regular intervals, and wherein other mechanism is provided for marking each hill planted.

CHEESE FOLLOWER.—L. H. PIEPER, 429 Caroline St., Plymouth, Wis. An object of the inventor is to provide a follower formed of a disk of metal provided with radially pressed ridges alternating with openings or perforations, whereby practically the entire area of the disk or follower may be utilized for the



CHEESE FOLLOWER.

proper drainage of whey, instead of the narrow grooves or channels utilized in the old-style wooden followers. It provides a metallic one-piece follower which is very thin, so that a greater amount of cheese may be pressed in any given press than could be pressed by the use of the old followers.

CULTIVATOR SHOVEL.—J. H. WRIGHT, R. F. D. No. 5, Jefferson, Iowa. This inventor provides a cultivator shovel of such design that the earth and weeds or grass or other matter will be prevented from clogging or sticking upon the shovel, as the latter moves along so that maximum efficiency is attained in pulverizing the soil.

Of General Interest

STREET SIGN.—J. N. EARLY, 127 Reade St., New York, N. Y. The invention provides a device including a sign and adjusting means particularly adaptable to a post which is clamped to the latter in a novel way whereby movement of the sign or signs after once being adjusted, as well as displacement of the sign plates constituting a portion thereof, is obviated.

DEVICE FOR MARKING EARTHENWARE.—W. B. GRAY, 1327 S. 22nd St., Louisville, Ky. The invention is an improvement in means for marking earthenware, especially of that character which is formed in sections, and the sections are afterward separated from each other, for storage in different places, or for use at different times. It provides a certain infallible method of identifying the several portions of any article, in order that there may be no difficulty whatever in identifying the missing portion.

PROCESS FOR THE MANUFACTURE OF SPELTER FROM FERRUGINOUS AND ADMIXED ZINC BLEND ORES.—J. J. FINGLAND, P. O. Box 507, Kaslo, B. C., Canada. The invention treats certain ores and products by a smelting process, for the recovery of spelter, and at the same time collects the lead, copper, silver, and gold, which may be contained in them, in the form of products amenable to their ordinary metallurgical treatment, thus rendering the recovery of the metal contents of the ores and products more complete and expeditious than possible by the ordinary process.

PROCESS OF PLATING OR DECORATING CHINAWARE OR GLASSWARE.—F. MOENCH, Rushville, Ill. An object of the invention is the provision of a novel process by means of which china, glassware, etc., may be plated with a permanent coating of aluminum, which is easily carried out by the use of materials and chemicals found in the ordinary laboratory.

VULCANIZING AND ATTACHING RUBBER.—F. MOENCH, Rushville, Ill. An object here is to provide a process by means of which rubber may be securely attached to such materials as glass, aluminum, steel, cast iron, tin, porcelain, gold, platinum and other material. It attaches rubber to other materials, and simultaneously vulcanizes the rubber during the attaching process.

STAR FINDER.—O. F. BARCUS, Shanghai, China. This inventor provides a star finder in the shape of a parasol on which fixed stars and the constellations are marked as a guide to be used in finding their location in the

STAR FINDER.

heavens. The stars are positioned relatively to the stick of the parasol so that when the outer end of the parasol stick is pointed to Polaris the stars on the parasol will be positioned for convenient observation.

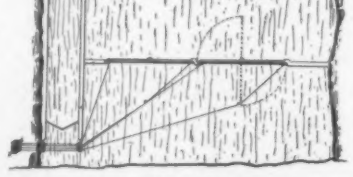
HATCH COVER FOR SHIPS.—A. N. MCGRAY, 119 W. 71st St., New York, N. Y. This invention improves the construction of hatch covers whereby they can be placed in closed position with the greatest dispatch and a minimum of labor, tightly battened down, successively withstand the downward crushing strains due to the breaking of heavy waves thereon, and effectively brace the coamings of the hatch opening without the use of strongbacks or stiffening bars extending across or obstructing such opening.

CIGARETTE BOX.—A. MENDELSON, 482 Marcy Ave., Brooklyn, N. Y., N. Y. This invention provides a box for containing cigarettes, cigars and like commodities, particularly with regard to their shape, in which individuality is presented as an attractiveness of the box, in addition to providing for convenience in filling the box and independently and conveniently extracting the commodities therefrom.

FILING DEVICE.—R. H. IRWIN, Stanfield, Ore. This invention provides a drawer or the like which is arranged to contain papers in bulk, while an auxiliary compartment beneath the main holder is adapted to receive a single paper, means being provided whereby the front end of the single paper will be positioned to display indicia thereon at the front of the filing element.

HORSE PROTECTOR.—J. W. NILSSON, Balfour, N. D. This invention provides a device for protecting a horse's head from attacks from bot-flies and other insects, consisting of a flexible strip of material suspended from a rigid frame and maintained in place thereon partially by a pair of clips, the latter serving as means for securing the protector to a bridle.

CONSTANT LEVEL CONTROLLING DAM FOR CANAL LOCKS.—F. A. RODRIGUEZ. Address D. Garcia, Lagos, Box 5, Montevideo, Uruguay, S. A. This invention provides a type of dam made up of sections which are controlled from one bank of the river, each section constituting a gate which is centrally pivoted on a vertical shaft, whereby the gate can be swung through an arc of ninety deg. from closed to open position, or vice versa, the gates



CONSTANT LEVEL CONTROLLING DAM FOR CANAL LOCKS.

being adapted to be opened in succession as the river rises, so as to provide an increased area of outlet of the dam, whereby the desired level can be maintained in the lock or sluice.

LOOSE LEAF BOOK.—J. W. MYATT, 37 Victoria Road, Tipton, Stafford, England. The invention comprises the employment of one or more flexible transverse retaining members in the back of a loose leaf book which at a convenient position are each formed with a narrow part over which the narrow portions of the notches in the leaves can freely pass, and the arrangement of the said retaining members so that there can be imparted to them a longitudinal movement whereby their narrow portions can be carried into alignment with or away from the notches in the leaves.

PORTABLE DARK CABINET.—G. LEACHMAN, New Cumberland, W. Va. This invention provides a cabinet having a table with a frame disposed above the table which is connected with the table by a hood, the rear of the frame being hinged to its forward portion so that the rear of the frame with the rear of the hood may be raised to permit the operator to place on the table the materials desired, and to enter the hood through an opening in the bottom thereof at the rear of the table.

ADVERTISING TWINE BOX.—H. K. KISO, P. O. Box 2437, San Francisco, Cal. The object here is to provide a box or container formed with a nest of boxes for receiving the various articles to be dispensed, and to provide these boxes and containers with spaces on which advertising matter may be readily placed and observed when the various contents are disposed of or vended.

PHOTOGRAPHIC ROLL FILM.—J. BREWER, 161 E. 122nd St., New York, N. Y. This improvement provides a film arranged to permit the removal of any one or a number of exposed sections of the film for separately developing such removed section or sections in case the removed sections require more or less time for development than the remaining roll film sections.

SHEET METAL CAN.—C. S. HARDY, 710-722 Sixth St., San Diego, Cal. This invention relates more particularly to a sheet metal can or pail, the body of which is provided with a rolled finished upper edge for the reception of the usual slip cover in order that the pail or can may be used continuously and for various purposes after its original contents have been removed.

INSULATING PIPE CONDUIT.—W. B. GRAY, 1327 S. 22nd St., Louisville, Ky. This invention is an improvement in insulating pipe conduits, and has for its object to provide a conduit having means within the conduit for carrying pipe supports of the character shown in Mr. Gray's co-pending applications, Serial Nos. 720,524, 709,262, 765,281 and 765,282, and the present application is a divisional application of his co-pending application, Serial No. 723,206 for a patent on separable earthern insulating pipe conduits.

REVERSIBLE BOAT.—T. H. GASKIN, Wellington Villa, Grove Road, Woodford, Essex, England. In the present patent the invention has reference to improvements in what may be termed reversible boats (or pontoons), adapted for being carried on shipboard and capable of being used in place of the ordinary life-boats with which ocean-going vessels are, as a rule, provided.

CENTRIFUGAL BASKET.—L. G. G. DIBBETS, Scheveningen, near The Hague, Netherlands. The invention relates to centrifugal filtering devices, and has reference more particularly to the centrifugal basket. It provides a centrifugal basket in which the material through which the sugar juices are to be filtered can be easily and quickly removed from the basket for cleaning.

Hardware and Tools

FIBER PHONOGRAPH NEEDLE CUTTER.—A. MONARD, 36 Elm Ave., Ridgewood, Brooklyn, N. Y., N. Y. An object here is to provide a device which comprises a pair of hingedly connected elements that are adapted to fit the thumb and second finger, like the handle members of a pair of scissors, one element having a needle-holding device of novel form and the other a cutting blade arranged so that by a movement of the elements, similar to the closing of a pair of scissors, the blade will trim the tip of a fiber needle.

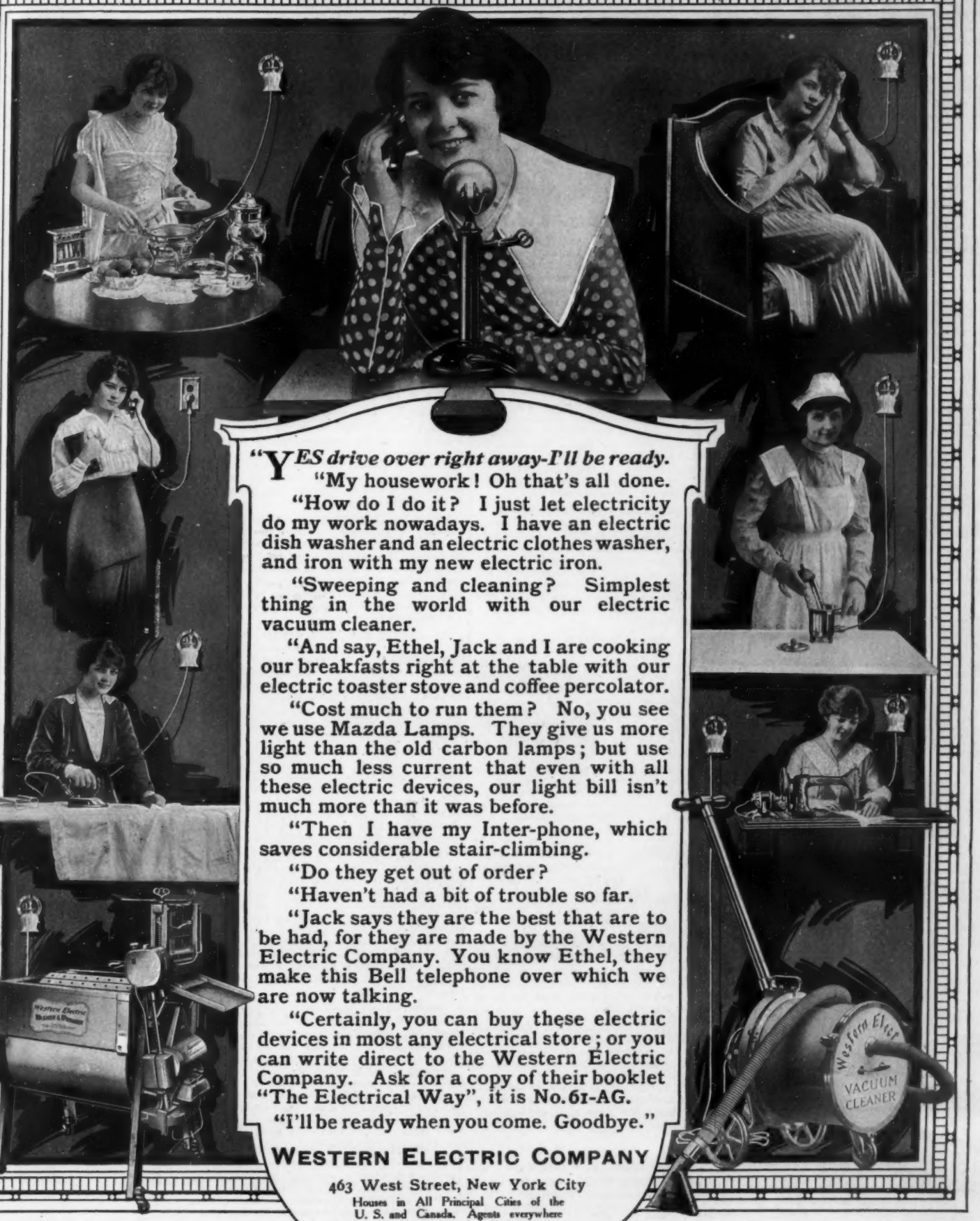
TOOL HOLDER.—J. M. CARPENTER, care of J. M. Carpenter Tap & Die Co., Pawtucket, R. I. This invention has reference to an improved tool holder and has for an object the provision of an improved socket for receiving a tool and a holding member coacting with the socket for causing the tool to correctly and accurately operate.

LIQUID MEASURING FAUCET.—A. MASS, 225 South 11th St., Newark, N. J. Among the principal objects in this invention are to provide a faucet operated in a conventional manner and provided with means for indicating the amount of liquid passing or passed therethrough; and to provide a simplified form of structure for the faucet of the character named.

LOADING HOOK.—J. UTSMAN, Fullerton, La. This invention to an improvement in hooks adapted more particularly for use in loading logs and the like, and one of the principal objects is to provide a hook of improved construction, and having an adjustable cap and pin which may be removed when necessary, for sharpening or substitution of new parts.

Heating and Lighting

HIGH WATER CONTROL FOR MULTIPLE DRUM BOILERS.—H. DUFF and H. LE H. SMITH. Address the former, 54 Wendover



"YES drive over right away-I'll be ready.

"My housework! Oh that's all done.

"How do I do it? I just let electricity do my work nowadays. I have an electric dish washer and an electric clothes washer, and iron with my new electric iron.

"Sweeping and cleaning? Simplest thing in the world with our electric vacuum cleaner.

"And say, Ethel, Jack and I are cooking our breakfasts right at the table with our electric toaster stove and coffee percolator.

"Cost much to run them? No, you see we use Mazda Lamps. They give us more light than the old carbon lamps; but use so much less current that even with all these electric devices, our light bill isn't much more than it was before.

"Then I have my Inter-phone, which saves considerable stair-climbing.

"Do they get out of order?

"Haven't had a bit of trouble so far.

"Jack says they are the best that are to be had, for they are made by the Western Electric Company. You know Ethel, they make this Bell telephone over which we are now talking.

"Certainly, you can buy these electric devices in most any electrical store; or you can write direct to the Western Electric Company. Ask for a copy of their booklet "The Electrical Way", it is No. 61-AG.

"I'll be ready when you come. Goodbye."

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THE OWNER OF A 2-38 PACKARD CAR purchased in April, 1914, would like to dispose of same. Price asked is very moderate. This car has been used only in the summer months and has covered a limited mileage. It is in excellent condition and may be inspected at the Packard Motor Car Company, Broad and Kinney Streets, Newark, N. J. Price may be obtained from the Company provided the name of this paper is mentioned.

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Inquiry No. 9642. Wanted the name and address of manufacturers of machines to make 2-color typewriter ribbons.

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Inquiry No. 9651. Wanted the name and address of a manufacturer of machinery for making egg albumen.

Inquiry No. 9652. Wanted the name and address of a manufacturer making machinery for the production of Tannic Acid from the Mangrove plant.

Inquiry No. 9653. Wanted the name and address of a maker of a machine for washing and drying bristles; also machine for cutting, combing and assorting bristles.

Inquiry No. 9654. Wanted the name and address of a manufacturer of a machine for sewing the mouths of bags which will make a ring at each end in addition to sewing the mouth.

Inquiry No. 9655. Wanted the name and address of a manufacturer of equipment for making enamel cloth, rubber, and drill cloth.

Road, Forest Hills, L. I., N. Y., N. Y. This invention relates more particularly to a high water control system, adapted for use in connection with a feed water regulator or for general notification of high water with or without automatic regulation of it, both in reference to multiple drum water tube boilers, causing the regulation or the notification to be in accordance with the water level in the drum where the level is highest.

Household Utilities

FLOOR MOP.—E. NAHR, 1050 Elm St., Long Beach, Cal. The present application is a division of an application filed by Mr. Nahr, Serial No. 830,883, and it particularly relates to the means for fastening a mop cloth on a mop head. The construction permits of the ready removal of the mop pad for washing, and the cap adapts it for effective use beneath furniture and in corners.

Machines and Mechanical Devices

GIMP OR PLATED CORD MACHINE.—J. G. SMITH and H. SWARTING. Address the former, 151 North 6th St., Brooklyn, N. Y., N. Y. This inventor provides a machine for making gimp or plaited cord in which, instead of covering the strands of the cord separately and then twisting them together upon a separate machine subsequent thereto, the strands, depending upon the number of plies, are covered simultaneously and twisted so that as the cord is taken off the machine it is completely made without requiring the additional twisting operation.

ANIMAL TRAP.—J. E. RUBY, 442 Highland Ave., Indianapolis, Ind. An object in this case is to provide a trap in which the trigger acts directly upon the dog or detent in releasing the trap jaw, at the same time being of such nature that automatic resetting of the trigger may be obtained by simply moving the jaw into the original or set position.

CONCENTRATOR HEAD MOTION.—W. H. REAGAN, JR., and J. R. MCMURRAY. Address Deister Concentrator Co., Fort Wayne, Ariz. This improvement refers to driving mechanism for concentrators, and an object is to provide an efficient mechanism wherein a perfect system of lubrication is provided, in which the oil is positively prevented from being thrown out of the centrifugal motion of the parts of the mechanism.

PUMP FOR CORROSIVE LIQUIDS.—ATTILIO FERRARIS, Turin, Italy. This improved pump not only eliminates many former inconveniences but means are provided for feeding the inert liquid to the pump without dismounting the same or removing any portion of it as well as for preventing the air from being sucked in the pump in the case the corrosive liquid should for any reason be missed and the pump discharged.

PRINTING CAMERA.—J. TRIMBACH, Rye, N. Y. This invention provides a photo printing device which will permit the printing of pictures or photographs from flexible films or photographic plates by artificial light and in such a manner that a strip of printing wound upon a roll or otherwise may be used and brought to printing position without many of the operations and manipulations now necessary in printing with an ordinary printing device.

SHUTTER CONTROLLING DEVICE.—D. L. BROWN, 187 W. 80th St., New York, N. Y. This inventor provides a device more especially designed as an auxiliary to the usually manually controlled shutter-actuating mechanism of the camera, and arranged to allow the person in charge of the camera to move to position in front of the camera with a view of having the person's picture taken either singly or in conjunction with a group.

VENDING MACHINE.—L. A. VALDETTARO, Box 187, Madison Square P. O., New York, N. Y. This invention provides means whereby the coin, after a certain number have been deposited in the machine and articles received therefor, will be diverted by a valve mechanism into the article delivery chute or way, so that the purchaser will have his coin returned to him in addition to the article he intended to purchase.

JIG.—W. S. TOWER and P. D. CAMPHUIS. Address the former, Northport, Wash. This invention provides means for moving the device in a substantially elliptical path and to adjust the inclination of the ellipse at will, with a consequent effect on the direction and speed of movement of ore in the jig; and directs the ore not concentrated through the bottom screen of the jig into suitable cups in such manner as to leave the tailings outside of said cups, the ore containing basket being movable within a tank containing water maintained at a level above the ore level.

RELEASING APPARATUS FOR LIFE BOATS.—R. TJADER, 51 E. 42nd St., New York, N. Y. The invention relates to ships, and has particular reference to apparatus for manipulating life boats from the decks of ships. More definitely stated, the objects are to improve the means for releasing a life boat from the ropes or cables associated with the davits after the boat approaches or reaches the water.

CHIROGRAPHIC REPRODUCING MACHINE.—F. SCHORNO, Allwood Road, Passaic, N. J. This invention provides for reproducing an exact copy of signatures or other chirographic productions; provides a machine for mechanical writing when operated by individualized and successively installed records; provides a marking tool variable by pressure applied thereon, and means for controlling said pressure, mechanically identified with the chirography being produced; provides automatic controls for holding in fixed relation the paper preliminary to imparting thereto the chirography produced by the machine, and provides means for varying the direction of the operation of the marking implement to simulate the movement of the hand and wrist.

WATCH ADJUSTING MEANS.—J. A. MEROZ, 139 Brown St., Waltham, Mass. The purpose here is to provide means more especially designed for mechanically adjusting watches without removing the balance, and to insure accurate running of the watch whether the latter is carried or held in vertical or horizontal position.

AMALGAM MIXER.—N. K. GARHART, care of Garhart Dental Specialty Co., 590 Massachusetts Ave., Cambridge A., Boston, Mass. This invention has reference to amalgam mixers and has particular reference to mixers of the type indicated for use, especially by dentists, in preparing fillings for teeth or analogous purposes. The action of the mixing device is very rapid and most effective.

ELEVATOR.—C. A. LARSON, Stromsburg, Neb. This invention, while useful for excavating, is more particularly for use in removing material from a silo. It provides an elevator in which an elevating conveyor is freely suspended from an overhead structure, and provided at the lower end with a structure supported on the conveyor and having its sole connection through the medium of said conveyor with the overhead suspending structure.

STRIKING ATTACHMENT FOR TIMEPIECES.—O. E. GISET, 30 W. 36th St., New York, N. Y. In the present invention the object is the provision of a new and improved striking attachment for watches and other timepieces, and arranged to strike the hours and half hours and to be driven from the main spring of the timepiece.

DREDGE.—J. R. HART and J. R. DAVIS, Conway, S. C. This invention provides a dredge of the suction type in which the liability of clogging of the blades is reduced, owing to the provision of a scraper on the inside of the cutter blades. It provides a scraping device which may be readily adjusted or applied to the device without the necessity of removing the cutter blades.

HYDRAULIC VARIABLE SPEED GEAR.—R. R. MORENO, Teniente de Fragata, Florida 659, Buenos Aires, Argentine Republic, S. A. An object here is to provide a speed gear of relatively high efficiency; also to provide, in a hydraulic speed gear, a novel form of mechanism for driving the pump pistons, and also for regulating the length of stroke of the pump pistons.

BILGE WATER EXTRACTOR.—S. S. JAMISON, Saltsburg, Pa. This invention relates to boats and more particularly to motor boats and the means for ejecting bilge water from the hulls thereof while the same are in motion. It is also adapted for use in the extraction of smoke and foul air. The device may be readily applied to any vessel and when in position will not detract from the appearance thereof.

WEIGHING SCALE.—T. B. POWERS, 212 W. 69th St., New York, N. Y. This invention eliminates frictional resistance in the working or moving elements of the apparatus; provides an apparatus having a simplified and durable structure; provides a registering mechanism simplified in construction and accurate in operation; provides means for justifying said scales, and provides yielding supports operatively connected in substantially parallel relation.

SPINNING MACHINE.—L. VANHAM. Address F. W. Dixon, 409 Pine St., Jamestown, N. Y. The inventor provides improvements in spinning machines, whereby the ordinary top board now generally used is dispensed with and accumulation of fly waste and loose fibers is prevented, to insure the formation of a thread free from fly or waste slubs, and whereby the spinner is enabled to quickly and conveniently make short piecing, and more room for doffing and setting of the bobbins is provided.

FEED MECHANISM FOR SAWING MACHINES.—G. A. ENSIGN, Defiance, O. This inventor provides a new and improved feed mechanism for sawing machines, arranged to insure a practically smooth, uninterrupted, steady feeding of the material to the saw, and to allow of running the feed mechanism at a high rate of speed thus increasing the output of the machine.

AUTOMATIC LAUNDRY VALVE.—C. A. LINDGREN and W. H. PERKINS. Address the former, Hawthorne, Mass. This invention relates to the control of water to a laundry machine or other device, and has particular reference to an easily controlled mechanism for the purpose of delivering either hot or cold water or a mixture of hot and cold water to a washing machine.

Prime Movers and Their Accessories

INJECTOR.—J. H. COOK, P. O. Box 1141, Tulsa, Okla. This invention provides a device which will distribute fuel equally to all of the explosion chambers in internal combustion engines, either two-cycle or four-cycle, under pressure; provides means for insuring an initial mixture to the cylinders upon starting the engine; and provides a device which may be used for kerosene oil, gasoline, or other distillates, as fuel.

VALVE CLEANER.—B. W. MASSEY and T. J. GOODWIN. Address the former, 307 Woolfolk St., East Macon, Ga. This invention relates to gage valves, particularly to means for cleaning the same. It provides such cleaning means which are readily attachable to a portion of the valve barrel from which certain normal parts have been removed. It provides means whereby the inward passage of the cleaning may be limited.

SPARK PLUG.—J. RICK. Address Charles G. Linker, 135 William St., New York, N. Y. This invention relates particularly to a plug which is designed to eliminate any short circuiting by reason of the building up of carbon at the sparking point. It provides a plug with a contact ball and a cup-shaped runway, whereby the ball will provide a path for the passage of current and will obviate any corners or projections where carbon may accumulate.

STEAM ENGINE.—M. A. Green, 120 North 52nd St., Philadelphia, Pa. The object of this improvement is to provide means which is controlled automatically by the steam without the aid of mechanism connecting to the moving parts of the engine to control and produce the proper compression when the engine is running non-condensing and condensing.

Railways and Their Accessories

TRAIN-DOORS CONTROL.—V. A. CONKLIN, 38 E. 35th St., Bayonne, N. J. The purpose in this case is to provide an efficient train-door control operable from the platform of a station, whereby all the doors of all the cars of a train can be simultaneously opened or closed by means of a contrivance provided on the platform of the station.

Pertaining to Recreation

ARTIFICIAL ELECTRIC MINNOW.—A. SAMPEY. Address Perry T. Allen, 408 Baker Block, Springfield, Mo. An object here is to provide an attractive and illuminated minnow for angling. The minnow comprises a wooden head and tail pieces, a body formed of longitudinal metal and celluloid strips, screw hooks secured on the metal strips, and barbed hooks attached to the screw hooks and swinging freely thereon.

Pertaining to Vehicles

AUTOMATIC VALVE AND HOSE COUPLING AND DUST CAP FOR PNEUMATIC TIRES.—A. BELIVEAU. Address M. T. Donahue, 2910 Walnut St., Chicago, Ill. The invention is an improvement in automatic valve and hose couplings and dust caps for pneumatic tires, and provides mechanism for connecting the dust cap to the valve casing in such manner that the cap may be used to clamp the air connector on the valve casing.

PROPELLING MEANS FOR VELOCIPEDES.—J. M. COOK, Mount Gilead, O. More particularly the invention relates to a driving mechanism of the type employing a reciprocating drive element, presenting spaced, internal racks, and a driven pinion in position to alternately mesh with the respective racks to the forward and return strokes of the drive element, the pinion being driven continuously in one direction.

CONTROLLING LEVER LOCK.—C. A. SCHULTZ, JR., and E. L. MCMANUS, JR., 109 E. 15th St., New York, N. Y. The invention has reference more particularly to locking means for the controlling levers of electric motors for vehicles. It provides a simple, easily operable lock for the controlling lever, whereby the lever is locked in a neutral position when the vehicle is at rest.

LOCKING DEVICE FOR HAND LEVERS.—A. H. MARHENKE, 861 Whitelock Ave., Bronx, New York, N. Y. This improvement provides an attachment for hand levers with improved locking devices whereby the hand lever, when employed for the control of automobiles or the like, may be left locked in a position or condition to baffle an attempt by any unauthorized person to move or disturb the machine.

Designs

DESIGN FOR A STOVE.—L. S. BIXLER, care of The Kenton Hardware Co., Kenton, O. In this ornamental design for a stove the article is shown in a perspective view of an upright gas stove of two burners, the ornamental features of which are of attractive scroll work. Mr. Bixler has also designed an upright gas stove of one burner in which the ornamental features above mentioned are strictly embodied.

DESIGN FOR A CUT GLASS DISH.—C. LEVIN, 589 Tremont Ave., Bronx, New York, N. Y. In this ornamental design the dish is oblong with rounded ends. The article is very simply but effectively ornamented by buds, stems and leaves, while a single spread-out flower graces the center.

DESIGN FOR A COMBINED KNIFE AND FORK.—A. W. COX, 76 Summer St., Malden, Mass. This ornamental design for a combined knife and fork is shown in side view, front and end view thereof, and in plain view. The implement in appearance shows a highly original design of very graceful form.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

20,000 Miles in 12 Months

There is so much "fuss" and noise about automobiles in general that the Electric Truck suffers to some extent just because it is an Electric—it is so quiet and unostentatious.

How a One-Ton G.V. Electric Disappointed the Critics

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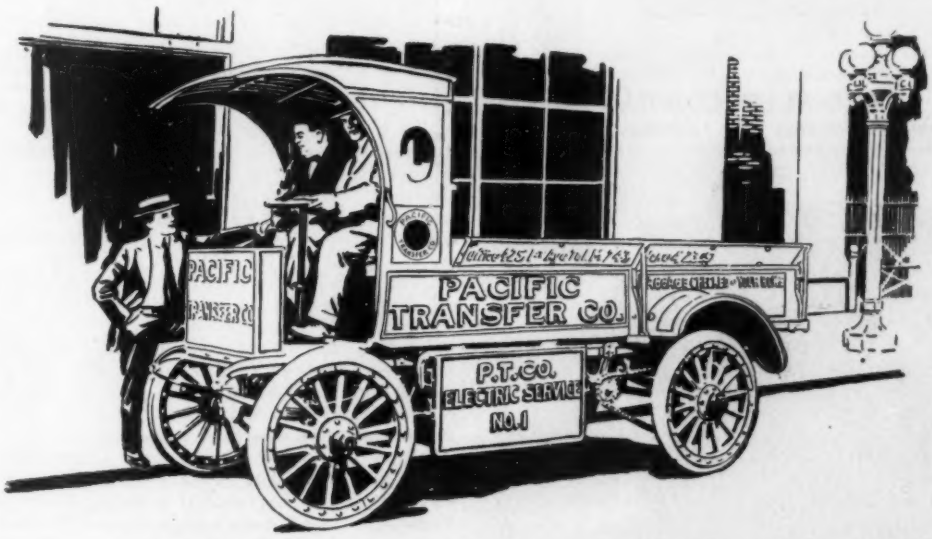
THE business man who claims that the Commercial Electric is "impractical," "no good," "needs a nurse" and so on, very frequently gets a short arm jolt when his competitor installs Electric Delivery. For example, consider the mileage question:

ELECTRIC Economy Facts. The 1-ton G.V. shown below ran 20,000 miles over Spokane streets between August 17, 1914, and August 15, 1915. "The cost to us" (states J. M. Watkins, President, Pacific Transfer Co.) "including complete garaging, battery service, tires and all other incidental expense, has been $1176.03, or .0587 cent per mile." . . . . . "It is doing the work previously done by three teams and wagons."



This G. V. Electric averaged 67 miles per day for 12 months, working 18 hours per day. Cost but .0587 cent per mile

Assuming that the truck does have duplicate batteries (and it is still working hard), the fact remains that it stood up under an 18 hour grind for 312 days, *averaged 67 miles per day* and cost less than a double team does most city firms. All we desire to prove is that this G. V. Electric was equal to the task given it to do.

Surprising Truths About 5-ton Electrics. We have great 5-ton G. V. Trucks in service which frequently make 50, 56 and even 60 miles per day with a battery "boost" at noon, something really phenomenal. But—we have hundreds of G. V. Electrics in service which pay in *direct competition* with horses in mill yards and on other shuttle work where the daily mileage is as low as 12 or 14 per day. The secret of successful Electric Truck operation is—*specific adaptability*. No "nurse" is needed—just a little common sense in operation and care, and this *any* truck needs. Naturally, some people who oil a truck only when it squeaks still prefer horses.

But, seriously, now, why not get really into this "Electric for the city" angle on delivery and settle the matter for yourself? Electrics are either what you need or they are not and don't say "not" until you are sure, because that's expensive. Don't jump either way—just make *sure*.

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Electricity in Present-Day Warfare

(*Concluded from page 494*)

hiding behind low-hanging clouds or taking advantage of foggy weather, are no longer immune from anti-aircraft artillery. Sensitive microphones now make possible not alone the detection of an invisible airship but its exact location as well. In the aerial defense of Paris there are employed microphonic sound detectors known as *poste d'écoutes*, or listening posts, consisting of four inverted megaphones for gathering sound waves, so mounted that they may be swung in any direction. The French listening posts, however, only furnish the approximate location of the hostile airship.

In seeking efficient protection against Zeppelin raids, the British have adopted a novel system of microphonic sound detectors developed by Dr. Lee De Forest, an American electrical engineer. Briefly, the system consists of a number of microphones mounted several feet above the ground on suitable supports and arranged at the corners of a geometrical figure of known dimensions. By adjusting the microphones until the sounds from an invisible airship are heard loudest in each detector and then taking readings of the adjustments of the microphones, the determination of the range of the target for the anti-aircraft artillery resolves itself into a simple problem of triangulation. It is important to mention here that the pointing of an anti-aircraft piece does not require the exactitude of naval artillery, since aerial artillery to-day employs shells of the shrapnel type which, upon exploding, scatter fragments over a wide area. Accordingly, only the approximate location of the target is necessary for the proper timing of the shell fuses.

Trench warfare and its offshoot, underground warfare, have brought about another application of the microphone. Almost daily the communiqués report the explosion of mines along the front, indicating the vast extent of sapping and mining operations. The reason is obvious: the power and precision of modern firearms have rendered imperative the breaking down of an enemy's strongly protected trenches by artillery fire or a mine explosion before an infantry attack can be undertaken. And of the two methods just mentioned, the mine explosion is the most favored on the Western front. Both sides are continually digging galleries from their own trenches towards the enemy's position with the object of placing a mine chamber filled with an explosive charge below him, which is exploded at the most opportune moment by electricity.

Men especially trained in detecting underground sounds are detailed to listen for the activities of enemy sappers. These men are usually capable of detecting not only the sounds of mining activities but also of determining the direction, height and the distance away of the source of the sounds. Although trained listeners seldom resort to artificial means for aiding them in their work, to obtain greater clearness under the more adverse conditions there are employed extremely sensitive forms of microphones which detect and amplify many times the faintest sounds.

The timely detection of mining activities is of utmost importance to the safety of the occupants of front line trenches, since counter-mining operations can be inaugurated immediately to foil the enemy sappers. Often it is possible to drive a bore hole in the direction of the sounds and to lay a *camouflet* which, on exploding near the attacking gallery of the enemy, causes the earth to crumble, either burying the enemy sappers beneath a mass of earth and debris or at least discouraging further efforts for the time being.

Directing Armies by Telephone

If the telephone is a modern business necessity, surely it is equally important to a modern army in the field. All the armies engaged in the titanic struggle are using telephones to direct the movements of the divisions, as well as for the directing of artillery fire.

Time was when the commander of a battery stood near his guns and shouted commands to the gunners. To-day, the artillery officer may be several miles away, in an improvised observation post within view of the enemy's works. The observation post may be an insignificant ruin, a tree top, a hole in the ground caused by a shell explosion, a haystack or a tall structure from which he can observe the accuracy of the fire from his battery and telephone the results to the gun pointers at the battery in the rear. He orders the range lengthened or shortened and tells the men when hits are being made. Should the enemy alter his position, the observer telephones the necessary information to the gun pointers so that the shells soon find the new mark. Thus it becomes a matter of prime importance for opposing forces to locate the opponent's observation posts, which are virtually the eyes of the artillery—excepting the aeroplanes, which also serve to this end. Indeed, modern artillery might well be compared to the engine room of a steamer wherein the engineer (gun pointer) starts and stops his engines (guns), runs them fast or slow (range), according to the signals he receives (verbal messages over telephone wires) from the pilot in the wheel-house (officer observer). The engineer of the boat does not see the direction in which the vessel is traveling, yet runs the engine as carefully as if he did. The pilot in the wheel-house sees for him, and the engineer has but to follow the signals he receives. So with modern artillery; the gun pointers seldom see the target at which they are firing.

Aside from the use of the telephone for observation reporting, it is employed to keep the commanding officers and general staff in touch with the men at the front. The latter may be many miles in the rear of the battle lines, yet the telephone serves them so well that they know what is taking place better than if they were in an exposed first-line trench. Indeed, modern generals are soon coming to be looked upon as belonging to one of two classes: plain generals and telephone generals. The former comes in close contact with the actual fighting, while the latter remains at all times several miles in the rear, sitting before a large map on which pins or small blocks indicate the fluctuations of the battle line in his sector. As to which type of general is the more capable it would be difficult to say until this war comes to be written. Safe it is to predict that the telephone general, remote from the battle front and its incidental noises and excitement, is in a better position to exercise his judgment with greater precision. It becomes a matter of cold, calculating science for him to direct the movements of his troops, with a minimum possibility of rash moves and errors.

Telegraph and Field Buzzers

Aside from the telephone, the telegraph and field buzzer are used to some extent, although this war has displayed a marked tendency towards using the telephone entirely, despite the fact that experiences have proved the buzzer to be more reliable than the telephone or visual signaling.

A typical buzzer equipment weighs in the neighborhood of five pounds, and is operated by current from two dry cells. It consists essentially of an improved type of buzzer, a sending key, battery, telephone receiver, condenser and minor accessories. The main advantage of the field buzzer is that it can be used in connection with a single-wire line and the ground, and that, should the line break or even become grounded, the signals will still be readable at the receiving end—a condition that would render either a telephone or telegraph system inoperative.

Wireless Telegraphy at the Front and at the Rear

Wireless telegraphy has not been used in military operations to the extent that was expected, due, no doubt, to the fact that on most fronts the armies have settled down to trench warfare, making permanent telegraph and telephone lines possible—and desirable. Wireless telegraphy on land comes into use when the armies are constantly on the move. The equipment is generally of such a nature

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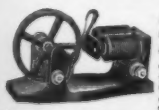

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that the portable mast, comprising a number of sections of a few feet each, can be erected within a few minutes' time and the set placed in operation in as many minutes more. Some sets are constructed for transportation on the backs of several horses, but in general the European powers favor the use of automobiles especially equipped as transportable wireless stations.

It is in espionage activities particularly that the wireless has tended towards the dramatic. Spies have not been slow to realize the immense value of radio apparatus in maintaining continuous communication with their own lines and in intercepting the dispatches of the enemy. A wireless apparatus for receiving and transmitting messages was discovered several months ago by the British police, concealed in the chimney of a suspect's house in England. Presumably, the set had been employed for intercepting dispatches and for signaling with German craft. Again, a British battery in Flanders was being located continually by the fire of the enemy, despite its efforts at concealment by frequent changes of position. Later, a cavalry patrol chanced to come across a large touring car in back of the lines, containing two men. They would have been released had not one of the cavalrymen noticed a piece of wire connecting with the metal work of the automobile top. A search revealed a complete transmitting set hidden in the car and employing the automobile top as the aerial. The distance between the car and the German lines at all times was but a matter of a few miles, so that communication was readily maintained with the improvised aerial. The men in the automobile had been observing and correcting the fire of their battery.

Airships have made good use of radio telegraphy in signaling ranges to artillery and reporting the movement of enemy troops. Before the war no great degree of success had been attained in the development of wireless equipment for aeroplanes, although since the opening of hostilities it would seem that the many difficulties have been overcome. Zeppelins are said to be equipped with radio apparatus capable of receiving and transmitting wireless dispatches several hundred miles, and this is logical, for even before the war the Zeppelins were carrying equipment of special design—transmitters of low tension, quenched gap type, so as to reduce the danger of sparks to a minimum—which they used with great success.

Electricity in the War Hospitals

Electricity serves other purposes besides aiding in the killing and maiming of men. It serves in many humanitarian capacities.

The X-ray has done much to eliminate guesswork in surgery, and the hospitals of the European armies are equipped with both stationary and transportable equipments. The latter make it possible to examine the wounded on the battlefield and to rapidly sort them into classes according to the nature of their injuries, before sending them to the base hospitals. Whereas in the past an examination required the better part of an hour, at the present time the X-ray enables examinations to be accurately made in less than one minute.

The transportable X-ray laboratories of the armies generally consist of a light automobile truck carrying a generator which is driven by the automobile engine, the X-ray coil, table, tubes, standards and other accessories. A dark room is partitioned off and equipped for the developing of radiograph negatives, although the examinations are usually made with a fluoroscope screen.

Electromagnets have been in use for several years for removing iron and steel splinters from the human eye, but their adaptation to the removing of splinters from the flesh is a novelty. The well-known French surgeon, Professor Bergonie, working at the Grand-Lebrun Hospital at Bordeaux, has been signally successful in using large electromagnets for this purpose. Radiographs are made from time to time, showing the progress

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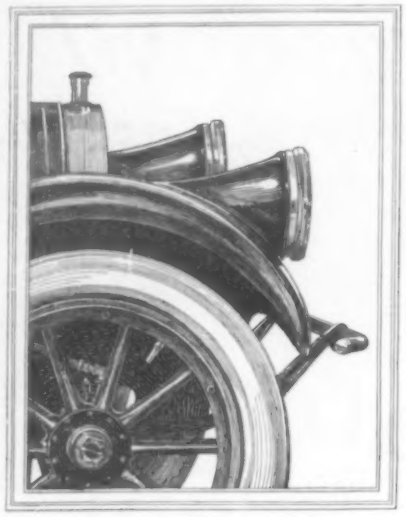

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of the splinter through the flesh, aiding in the proper manipulation of the magnetic flux. Aside from the use of the X-ray for locating metal splinters in the flesh, there have been developed other methods making use of telephone receivers and batteries and depending upon the variation of electrical resistance.

The providing of pure drinking water has always been a problem confronting an army, but to-day, thanks to the germicidal properties of the ultra-violet rays, any water supply can be used without danger of infection. The armies of Europe are employing electricity in operating ultra-violet ray water-stills, through which water of questionable purity is passed before use.

Battleships and Their Electrical Equipment

Naval warfare has kept pace with military warfare in the matter of applying electricity to its purposes. Electric lighting aboard warships is too familiar to require elaboration here, which likewise is the case with electric motor drive, which is used extensively in operating a war vessel's machinery. Telephone systems insure instant communication between different parts of a ship, and, as in the instance of land artillery, an officer directs the firing of the guns by telephone.

Wireless telegraphy finds its greatest employment in the naval activities, since it maintains communication between fleets and the naval bases.

It is electricity that has made the modern submarine so effective. When running beneath the surface the oil engines cannot be used, and recourse is had to electric motors that derive their power from accumulators. While running awash or on the surface the oil engines not only serve to turn the propellers, but also to charge the storage cells.

Locating Submarines by Microphonic Detectors

The wholesale destruction of German submarines in the waters touching the British Isles is credited to a little microphone that can be held in the hand—many of them, which now dot the coasts of England, Scotland, Wales and Ireland, and the channel coast of France.

The British fleet was of but little use against the invisible German submarine raiders until a means of detecting the invisible craft was introduced. An American electrical engineer, William Dubilier, working in conjunction with Professor Tissot of France, has developed a submarine detector system which not only detects the presence of underwater craft but also their exact location. Briefly, each station comprises a steel casing submerged several feet below the surface of the water, fitted at one end with a metal diaphragm. Within the casing is placed a sensitive microphone. In front of the microphone are placed adjustable resonance tubes or sound filters. The resonance tubes only permit the shrill, high-pitched note characteristic of submarines to reach and affect the microphone, while all other low-pitched sounds are filtered out. Air pressure is maintained inside the steel casing to offset the pressure of the water and to prevent it from entering. The entire microphone apparatus is pivotally mounted, so that it may be swung in any direction to pick up the submarine sounds. By using two such microphones and adjusting them until the sounds are heard loudest, it is possible to determine the exact location of the sound source by means of triangulation, as well as whether it is in motion and, if so, its course. Destroyers and fast motor boats, or even a seaplane, can be dispatched to the spot and hover about until the submarine comes to the surface, when it can be destroyed or captured.

Contact mines have been used almost exclusively in the present war, although it is safe to assume that electrically fired mines have been laid in harbors. The latter are connected by electric cables to an observation post on shore and are fired by the depressing of a key or the throwing of a switch. Obviously, electric mines are absolutely safe to friendly craft, in marked contrast to the treacherous contact mines, which deal destruction to friend and foe alike.

Recent German Naval Construction

(*Concluded from page 484*)

development of the previous "Seydlitz." As in the "Koenigs" the *en echelon* system has been abandoned in favor of two pairs of super-imposed turrets, and these ships mount two guns less than the former type to increase the calibre from 11 inches to 12 inches. Again we notice that these battle-cruisers, laid down in 1913 and displacing 26,600 tons, have the same armament as the British "Indomitables" (the first ships of the true battle-cruiser type) laid down six years earlier and only displacing 17,250 tons. Perhaps the most noticeable innovation, however, is the battery of twelve 3.4-inch guns mounted high up in the superstructure amidships, a position which would give greater chance of beating off an attack by hostile submarines. Also, as defence against air-craft, an unknown number of anti-aerial guns are being mounted, and a 4-inch protective upper deck is provided.

The "Salamis" is a vessel of 19,500 tons and mounts eight 14-inch guns in four turrets: two forward and two aft, the innermost turrets super-imposed. Designed for only 23 knots, she does not mark any particular advance in warship design, being, rather, an effort to combine the greatest defensive and offensive qualities with the least cost.

In conclusion we find, therefore, that beyond a considerable increase in submarine output, Germany could not have increased her fleet in any extraordinary manner; neither does she appear to have introduced any new phase or notable advance in the ships she has constructed since the commencement of the war.

Future Possibilities of Electricity

(*Concluded from page 490*)

electric currents or discharges, ranging in the hundreds of thousands per second, result in such a lot of entirely new phenomena that it would be merely speculative to prophesy the applications of the future. It will have to suffice here to say that there may be many.

No great reduction in transmission losses over power transmission lines can be looked for, as they are already relatively small, and because nature has not given us any materially better conductor than copper. That the maximum in high transmission voltages has been reached or nearly so, is likely, as the difficulties seem to increase rapidly as the voltages are increased. Important improvements will, however, no doubt, be made in many details to make the service more reliable. Also in the interconnection of different power houses over large districts. The production of electric power directly at the coal mines, and conveying the power instead of the coal, to the large cities, will, no doubt, be an important development of the future, as the cost of the excessively high freight is no doubt far greater than that of the electric transmission.

Where the frequency of traffic warrants it, as around large cities, or where long or frequent tunnels demand it, or where ample water-power exists nearby, as in some of the trans-mountain lines, electric traction will, no doubt, continue to replace that by the steam locomotives; and with the improvement of alternating current motors, that current will be given preference over the direct, if not governed by other considerations. But there are many cases in which the steam or oil engine locomotive will still be the cheapest method for long distance railroad traction.

The present very high efficiency of dynamos, motors and transformers leaves no prospects for important future improvements in these apparatus, as far as transformers of energy are concerned; they are nearly perfect already, in this respect. Great improvements of a revolutionary character would be possible only by the discovery of entirely new and different principles and methods, that is, by abandoning present paths and taking entirely new ones, as is true also of other apparatus and methods used at present; but a discussion of these possibilities

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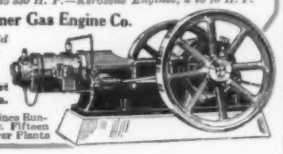

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would lead into speculative dreamland, which is beyond the purpose of the present prophecy.

The Intermittent Waterfall

(*Concluded from page 493*)

of convenience or luxury destined for each other's comfort or enjoyment, all sink to a whisper, vanish!

"A minute later and the crest of a vast billow sweeps over the brink of the American Fall. In an instant, almost, with a deafening roar of exultant joy, the cataract has sprung into full activity. Swiftly the falling curtain spreads from Goat Island along the crest of the semi-circle until Niagara, in full panoply of power and might, hurls her defiance at the assembled thousands gathered to witness the most wondrous sight on the face of the globe—the rebirth of a cataract. The spectacle would combine all the swiftness of movement and stupendous grandeur offered by the sweep of the Johnstown flood, or the tidal wave of Galveston, free from the tragic terrors and horrors of those cataclysms. The gloomy, beetling cliffs disappear behind the sheet of foam and spray; rainbows hover in the clouds of mist; the gray walls of the gorge echo back the roar of the proud cataract!

"In a less dramatic and spectacular manner the level of water in the gorge would steadily rise; the foam and spray of the rapids become evident; the whirlpool resumes its circling activity; and Niagara's normal life reappears.

"For ten hours the thousands of machines, of furnaces, of electrolytic vats, rest or are available for repairs, until the sun sets, and in the twilight the hour approaches for an eager multitude to witness again the death agony of a cataract.

"Such would be the daily sequence of events. On holidays, on the Sabbath, the lovers of nature could view the falling sheet of water at all hours of day and night, in the twilight, at dawn, in the solemn quiet of midnight."

Utilization of the Cataract While in Normal Activity

For many electrochemical industries it is imperatively necessary that the generation of current should take place without interruption. This is largely the case also when motive power is supplied to street car and railway lines. Resort may be had to storage batteries, but this increases very materially the average cost of an electrical unit.

As an integral part of the general project Prof. Norton has solved this problem in an exceedingly simple and clever, but totally novel manner. The plan provides for the rescue of a very large share of the power which normally would go to waste during the shorter portion of the daily period, when a cataract would be released from its fetters, without affecting in any noticeable manner the scenic beauty.

It may be briefly outlined as follows: In the deep recesses behind the falling sheet of water at Niagara, the Cave of the Winds, etc., a gigantic system of scaffolds would be erected. These would serve as the supports of a series of overshot wheels or endless chain-bucket wheels. By careful disposition a considerable fraction of the available power—possibly 30 to 40 per cent—could be utilized and directed to electrochemical or transportation centers without revealing any portion of the mechanism to the eye of the beholder gazing at the cataract. There would be a noticeable increase in the volume of spray, which could tend only to heighten the scenic beauty of the waterfall.

Wolcott C. Foster, a prominent consulting engineer of New York city, has devoted much attention to this unique feature of Dr. Norton's general plan and the possibilities which it offers. He has outlined a series of buckets, operating on endless belts, working on axes located immediately beneath the brink of the cataract and at the base of the falling sheet of water. This would mean essentially an enormous overshot water wheel, with its modern effective devices on the periphery, distorted and elongated into the form of a belt, as used for the transmis-

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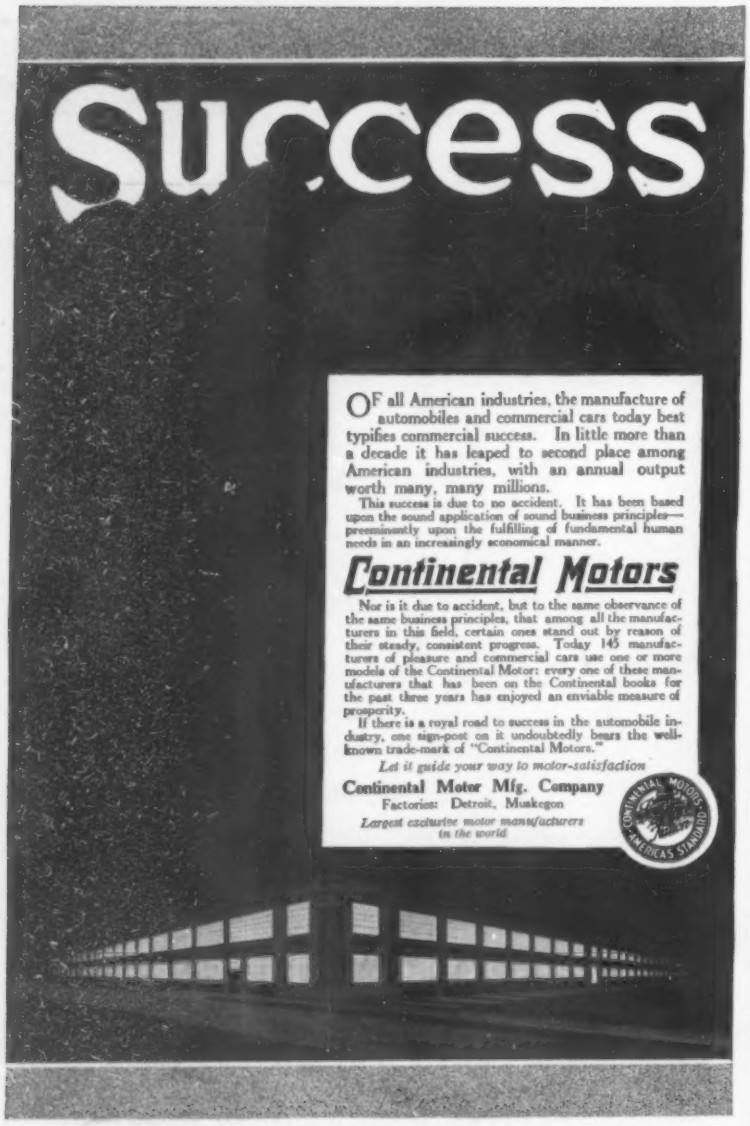
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OF all American industries, the manufacture of automobiles and commercial cars today best typifies commercial success. In little more than a decade it has leaped to second place among American industries, with an annual output worth many, many millions.
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"Shells and the Man" is a comprehensive study of the work of Lloyd-George, England's Minister of Munitions, by Isaac F. Marcosson. The reorganization of the munition industry in Great Britain, its bearing on the future of the Allies' cause and the importance of the work of the man who did it, make this article one of especial interest to "unprepared" America. It appears in the December 4th issue of

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sion of power from one shaft to another. A complete series of such elongated wheels, closely adjusted side by side, would occupy the entire space behind the curtain of falling water, as far as their presence could be concealed from the view of those on the adjacent banks.

Mr. Foster suggests another ingenious utilization of the cataract while in activity, viz., the collection of the air carried down by the water under pressure, at the foot of the falls or from the pool in which the water pours, and the employment of the compressed air as a source of power. In other words, the falls would be converted into a giant air compressor!

He adds, in this connection:

"At first blush many people may be inclined to condemn both or either of these methods, and, in fact, any suggestion for developing power from the curtain of falling water, as impracticable. This condemnation would result not from its being an inherent impossibility, but rather because of its novelty.

"While it may not be possible to develop all of the energy represented by the falling water, still it may prove not only possible, but probable, that a considerable percentage of it can be utilized. Not many years ago it was impracticable to use centrifugal pumps for elevating water much over twenty feet; to-day they are used for any height, and lifts of 1,000 feet are not uncommon. This development came from the careful study of the principles involved and the details of construction. It is probable that similar efforts, devoted to the study of the falling curtain of water would eventually lead to equally successful results."

Arrest of the Recession of Niagara Falls

Several subsidiary problems present themselves in connection with the projected utilization of Niagara's flow on so stupendous a scale. The first of these relates to the permanence of the mechanical installation behind the curtain of water.

Such an installation must evidently be of the most substantial character and, in consequence, of a somewhat costly nature. Any necessity for the alteration from time to time of the exact location of the powerful supports of the movable elements, even for a few inches, might involve a heavy outlay.

As a result of the geological formation, Niagara Falls is steadily receding. The rate of this recession has varied at different epochs, during the period of nearly 40,000 years which has elapsed since the cataract began to carve its way southward from the escarpment at Queenston and Lewiston. At present the recession of the American Fall averages less than 2½ inches yearly. It is much greater in the case of the Horseshoe Fall, ranging from 4.2 to 5.3 feet for the past century, and probably for the past 250 years.

The brink of the Horseshoe Fall is formed by 80 feet of hard, massive (Lockport) dolomite. Beneath this are 60 feet of relatively soft (Rochester) shale, extending nearly to the level of the pool below. This rests upon another layer of hard (Irondequoit) limestone, 15 feet in thickness. Then follows a thin stratum of hard (Thorold) sandstone, the soft, shaly sandstone of the albian formation—extending 50 feet below the level of the pool—a layer of whirlpool sandstone, 25 feet in thickness, and finally a stratum of soft, red (Queenston) shale over 300 feet in thickness. Summarizing, a massive layer of hard, compact limestone overlies several hundred feet of relatively soft shales containing a few thin strata of hard rock.

The erosion of the hard dolomite at the brink of the Falls is inconsiderable as a factor in the carving of the gorge. This is chiefly due to the scouring of the bottom and sides of the pool at the base of the Falls, where the mass of falling water strikes. The shale is gradually worn away; the hard layers are undermined; blocks of limestone and sandstone fall into the pool, where the tremendous turbulence of the water spins them round and round after the manner of pestle stones in the genesis of potholes.

As a result the brink of the cataract is always an overhanging ledge, projecting beyond the face of the supporting rock wall. Whenever a block falls from the brink it causes a recession of the overhanging ledge and contributes a new tool for undermining the softer rock at the base.

Evidently this slow but continuous process of gorge building must be definitely and permanently arrested. It is not a complicated nor a very expensive matter. The brink of the falls can be sheathed by resistant steel. A protective coat of concrete can effectively arrest the erosion of the soft shales beneath and of the walls of the pool. These latter will be laid bare to the depth of 86 feet during each period of the complete harnessing of the Falls. The average depth of the pool at the base of the falls is 160 feet; the greatest depth, 192 feet.

Diversion of Water to the American Fall

Another problem is connected with the unequal distribution of the water pouring over the cataract. At present but 4.5 per cent of the entire volume finds its way over the American Fall. The Horseshoe Fall absorbs 95.5 per cent. This uneven distribution is due to the character of the river bed west of Goat Island and the conformation of this island.

Maurice Deutsch, a well-known engineer of New York city, who has devoted much time to the study at Niagara Falls itself and the details connected with the practical execution of Dr. Norton's project, proposes a most simple and inexpensive method for the rectification of this inequality. His genial solution of the problem is based upon the construction of a low, scarcely visible breakwater southeast from the tip of Goat Island, through the shallow waters towards the international boundary line in the center of the river. As a result, a vast amount of water which at present sweeps from the American side of the river over towards the Canadian shore would be diverted into the comparatively narrow channel leading to the American Fall, without visibly affecting the appearance of the Canadian Fall.

The average depth of the water on the crest line of the American Fall is 3.5 feet. The depth on the crest line of the Horseshoe Fall varies from 10 to 25 feet. It is evident that any effort leading to an equalization in depth at all parts of the two Falls, will contribute largely to increase the average percentage of power, which may be rescued from the falling curtain of water by the system outlined above.

A Curtain of Water

A third problem relates to the appearance of the Falls, during the diurnal period of inactivity, should the project for rescuing the maximum power available from the falling curtain be put into execution.

It is scarcely necessary to state that during the 14 hours of enforced quiet and rest, while the waters of the Great Lakes are diverted through a maze of penstocks, to dash upon thousands of turbines, the sight of a serried array of mechanical devices, lining the cliffs of Niagara, would be sadly out of harmony with the otherwise gloomy grandeur of the gorge. Although these hours are largely those when the mass of population are slumbering, still, for several hours in the evening, and during the early forenoon, tourists and others would constantly gaze upon Niagara at rest.

To screen the mechanism of industry entirely from their view, Prof. Norton proposes to allow one per cent or less of the river's volume to pass from the impounding dam, and generate a thin curtain of falling water just enough to hide the massive scaffolding and the maze of wheels. This could best be accomplished by building a low, submerged dam just above the crest.

What the Project Means for the Niagara Region

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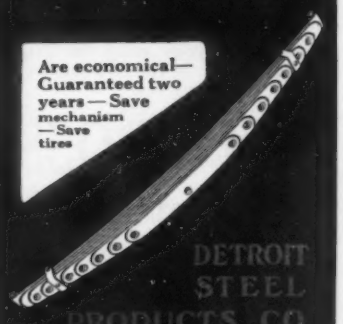

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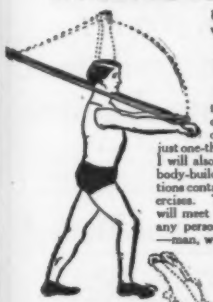

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would render the Niagara project almost unique among the world's great sources of electricity. The actual cost of production would not much exceed the lowest record, viz., the rate of $2 per annum in Iceland, or of $3 on the West Coast of Norway.

It is doubtful whether the initial outlay would much exceed $200,000,000. This would mean a capital outlay of $27 per annual horse-power; or an annual interest charge of less than $1.75.

What would this all mean for the regions adjacent, for southern Ontario and for western New York? In a recent address before the New York section of the American Electro-Chemical Society, Prof. Norton eloquently answered the query:

"It would mean the creation of an industrial metropolis, surpassing any now existing on the face of the globe. No cinders or soot would pollute its atmosphere; no towering chimneys would rise against the sky-line. Industries of the most varied nature, dependent upon the electric current, would gravitate to this point. It would become in very truth—perhaps in name—the *Electropolis* of America!"

Strategic Moves of the War, November 24th, 1915

(*Concluded from page 486*)

Pass, Tonale Pass and the Val de Sole, Storo near Lake Idro; and on the eastern frontier at Arsiero, down the Val Sugana, and the Val Cordevale. Through these gaps in the mountains the Italians have penetrated, have taken the fortifications guarding their entrance, and occupy commanding positions well beyond their own border. At several points they have gone well beyond this mere defensive occupation. Notable among these are at Storo, where they have directed an offense aimed at Riva and down the Val Sugana, and its southwest branches towards Roveredo, the former at the head of Lake Garda, the latter in the valley of the Adige, guarding the approach up that valley to Trent. In the Riva section they moved eastward along the border of Lake Idro and thence along the valley of the Ponale river, a small stream connecting Lake Idro with Lake Garda, containing several waterfalls which supply Riva with power for its lighting system. The Ponale is in Italian hands for its entire length and the Italian forces are within two miles of the city itself. The advance down the Val Sugana has not met with the same degree of success. Although many important heights have been taken, the Italians are still five miles distant from the city and apparently are content to hold what they have taken, leaving the main offensive to the army on the Isonzo. Farther north, in the Val Cordevale, particularly about the Col de Loma, there has been great activity, but this mountain is so far removed from the Adige Valley that its influence on the operations directed at Riva, Roveredo and Trent is practically nil.

As has been stated, however, the Trentino operations are essentially defensive in character, the true offense being conducted along the southern Isonzo. Along the front the Austrians have been satisfied to remain altogether in a defensive atttude. The demands for men have been so great in other theatres that they have not been able to send enough men into the Italian field to operate on any other basis. The general elements are readily seen from the accompanying map, remembering that the objective of the Italians is the city of Trieste. It is perfectly obvious that an advance on that city must first involve the reduction of the fortified camp at Gorizia. Otherwise the Austrian forces at the latter point could by an attack on the Italian line of communications render nugatory any offensive the Italians might direct from any one of the cities to the south which have already fallen into their hands. This would be the fate for example of an offense from Monfalcone, which would naturally follow the railroad line from that place to Trieste.

Gorizia itself is situated in a small flat plain, almost at the level of the river. On all sides except that fronting on the

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Isonzo it is surrounded by a group of heavily intrenched hills, and it is these that give the city its defensive strength. These hills have been lined with Austrian artillery which up to the present writing has held the Italians at bay. Just north of Gorizia the mountain country comes down rapidly to the plain on which the city is situated. The Isonzo here comes through a deep gorge-like ravine into the open country, and breaking away slightly to the west, follows along the western foot of a large table land, the Plateau of Corso. Directly west of Gorizia, on the other side of the river, are found the mountains, on one of the spurs of which is the town of Podgora, below which run both the railroad and the highway into Gorizia. Because of the fact that this highway and railroad cross the river at the foot of the elevation on which Gorizia is situated, and because also of its excellent position for observation and artillery, Podgora would seem to be absolutely essential to the Austrian continued possession of Gorizia. It is scarcely a mile and a half away and absolutely dominates Gorizia and the hills in its rear in every way. The northern top of the plain on which Gorizia is situated, while considerably more distant from Podgora than is the city proper, is still within comparatively short range for heavy artillery and is moreover controlled from the heights of Oslavia north of Podgora on the same side of the river. Podgora has therefore been one of the points which have borne the brunt of extremely heavy attacks and is reported, together with Oslavia, to have fallen into Italian hands. If this proves to be true, the fall of Gorizia is much nearer than Austrian reports would lead us to believe.

Another point of interest in the fighting along the lower Isonzo is the battle for the Dobrado plateau, some three miles southeast of Gradisca. The Austrians here are well entrenched and have offered a most effective resistance to the Italian advance. The Italians have however secured good foothold on the plateau and are slowly pushing the Austrians back. This will be somewhat facilitated now by the capture a few days ago of the heights of San Michele and San Martino del Corso to the northwest of the plateau, both of which are considerably higher than any other points in the vicinity. The fighting on the plateau itself has been trench warfare pure and simple, entirely analogous to the fighting in France. The advance has been extremely slow, is measured in fact in yards.

Once Gorizia falls, the way to Trieste is clear. The country between the Isonzo and the railroad entering Trieste from the north is for the most part open and there is not a single fortified place between. From Gorizia there is a railroad line straight to Trieste which will mark the line of the Italian advance. The Italians, with the bridge head over the river in their hands, will be able to clear all of the west bank of the river of Austrians and will then control this bank from Plava to the river mouth. Pivoting there either on Plava or Tolmein, their superiority in numbers will enable them to push across the open country to the south and bring again under Italian rule their citizens who for years have been looking forward to the day when they should again be living under the flag of King Humbert.

Electric Heating and Cooking

(*Concluded from page 496*)

the process is automatic and does not require the attention of the housewife. During the latter part of the afternoon the housewife need not be tied to her kitchen, as all that would be necessary at that time would be to dish up the food and serve it.

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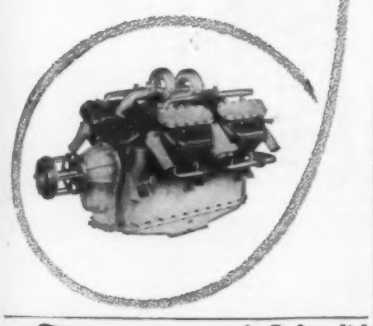

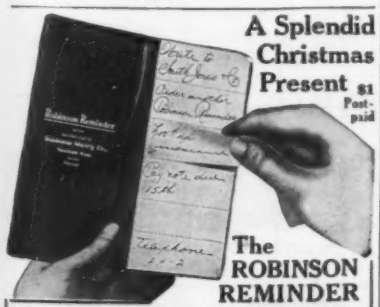

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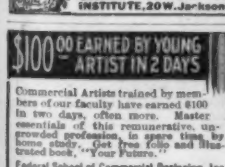

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in a well insulated oven to keep the food hot enough to serve for an hour or more after the current is turned off.

In cookery as in photography the time and temperature methods will benefit the amateur to a greater extent than the professional, who because of his years of experience and many failures in learning will be able to get uniformly good results with the less definite methods. Hence the greatest field for an automatic electric oven will probably be in the middle class home where the cooking is done by the housewife rather than by servants.

The Future of Radio Telephony

(*Concluded from page* 485)

operation are simple, as for instance in direct operation between two single wireless telegraph stations, this erratic variation must remain a very substantial hindrance to an economical and wide use of radio telephony as a link in a complicated telephone system covering a continent.

Unfortunately for the radio engineer the electrical impulses purposely radiated from the sending antenna are not the only impulses surging backwards and forwards through space. The more troublesome of these are due to natural causes originating wherever adjustments in electrical equilibrium are taking place, as in the case of lightning discharges, and are generally grouped under the term "static," or, as they have been termed by some wireless workers, "X's." Another difficulty of a somewhat similar nature is that wireless receiving stations are susceptible to induction from near-by power circuits or near-by electrical apparatus, especially that whose use involves rapid electric surges. With the present limited use of wireless, this latter trouble can be avoided by carefully choosing the location of receiving stations, but it would become a serious factor if the use of radio telephony became at all general. The interruptions due to static are, however, so serious that, at the present time, this factor in itself effectually bars radio methods from superseding wire working, where such can be maintained. While very probably methods somewhat mitigating the effects of static may be developed in the future, no economical and effective means have been disclosed up to the present time.

Inherently wireless telephony is nonsecret for the reason that in wireless working all interested make a common use of the same conductor, namely, the ether. No matter how complicated or unusual the apparatus and system employed by one group, the instant another person with the ability to use it obtains a similar type of receiving set the element of secrecy vanishes. Under any conceivable conditions this factor of non-secrecy is a very vital defect of wireless as a substitute for a wire plant.

Even more fundamental in the nature of things is the fact that, while radio telegraphy requires the transmission through space of electrical oscillations of but a single definite frequency, radio telephony on the other hand requires for its successful transmission a band or group of frequencies depending upon the range of pitch of the human voice. To illustrate, assume it is desired to employ for wireless signaling a fundamental or unmodulated wave of 5,000 metres in length corresponding to oscillations of a frequency of 60,000 periods per second. In the case of telegraphy this frequency only is sent out and it is theoretically possible to tune so sharply to this frequency as to enable another sending to be made at a frequency extremely near to this. In fact the degree of closeness is only limited by the refinement and complication of apparatus and method permissible. On the other hand, in the case of radio telephony the limitation referred to above enters, so that when a current, normally of 60,000 periods per second, is modulated telephonically, the currents resulting from such modulation cover a range in frequency of several thousand periods per second. If, therefore, it is desired to avoid overhearing and confusion of sounds it is necessary, even with ideally perfect apparatus, to employ fundamental frequencies as far apart as several

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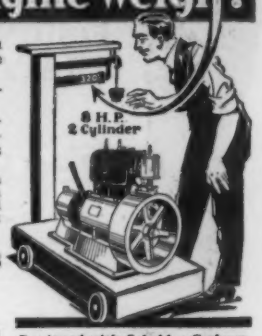

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thousand periods per second. Practically these fundamental frequencies must be separated by substantially larger frequency intervals. When one considers the relatively limited frequency range which is even theoretically available, say, from 20,000 to 2,000,000 periods per second, without making any allowances for legitimate and most necessary radio telegraph operation, it is seen to be impossible to carry on a large number of simultaneous radio telephonic conversations in the same locality. As a matter of fact the present assignments to indispensable radio-telegraphic use, such as to commercial ships and the Navy, reduce the theoretical maximum number of telephone paths possible by nearly one half.

For the reasons above and for others which cannot be touched upon in a paper of this length, it has become evident that radio methods cannot in any large degree supersede wire methods. On the other hand there are very important fields in which it is not possible to use wire telephone methods and here radio telephony will be adopted. A transoceanic telephone cable is not an engineering or commercial possibility, and hence to enable America to talk to Europe and Asia wireless telephony will be the means chosen. In extending the possibilities of radio communication between ships at sea there is a field for telephony, while from ship to shore radio telephony is the only possibility. These are a few of the fields open to the wireless telephone.

It may not be amiss to add a word regarding the relation between radio telephony and telegraphy. The telegraph will profit much from telephony on its engineering side and very likely suffer little, if any, from competition on its commercial side. On the whole, achievements in radio telephony will be a gain to radio telegraphy.

To sum up, the recent developments in the field of radio telephony promise the extension of telephonic communication to points incapable of being reached by wire telephony, in fact they make universal telephony an engineering possibility. The combination of wire and radio telephony is indeed a notable contribution to mankind.

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TEXT-BOOK OF ADVANCED MACHINE WORK. By Robert H. Smith, Massachusetts Institute of Technology. Boston: Industrial Education Book Company, 1915. 8vo.; 575 pp.; 609 illustrations. Price, $3.

There is a scarcity of text-books on this subject that are at all comparable with those of other arts and sciences. This text has been adapted by the author to follow his "Principles of Machine Work," and it presents, logically and progressively, engine lathe work, cutting tools and measuring instruments, and the use of the lathe in such operations as turning, fitting, threading, chucking and reaming. Perspective and mechanical drawings graphically illustrate the mechanisms, the tools, and the methods. That efficiency may be developed, a schedule of operations is given which provides a complete plan in table form for the rapid production of standard work in machine construction. For the student this book provides a complete, well-arranged and well-presented treatise on modern machine shop practice; to the instructor it offers an organized course, not merely in basic operations and processes, but also in scientific efficiency as applied to those operations and processes.

COMBUSTION AND SMOKELESS FURNACES. By Jos. W. Hays, Combustion Engineer. Rogers Park, Chicago: Jos. W. Hays, 1915. 8vo.; 118 pp.; illustrated. Price, $2.

The chimney constitutes a bond of interest between the general public and the furnace, for the smoke nuisance damages the public to the extent of millions of dollars every year. It is to the owners and engineers of steam power plants that the author makes his most direct appeal, warning them that of the fifteen hundred patented devices advertised to cure the smoke evil hundreds are totally impractical and most of them are flagrantly inefficient. His first chapter establishes the necessary understanding of the laws governing combustion. The application of these laws to the furnace and the steam boiler is then carefully explained. This clears the way to an intelligent discussion of that moot point—can smoke be burned? The author supports the affirmative by simple experiments, and cites the requisites of the smokeless furnace. His work should materially aid in reducing those "crimes against the boiler" that, paralleled in any other part of the factory, would "call down the wrath of everybody connected with the institution."

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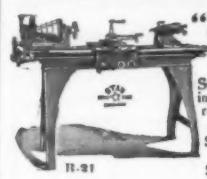
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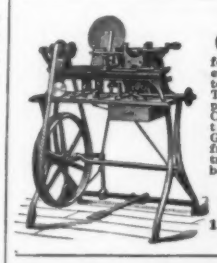
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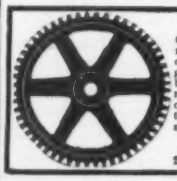
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